ALTERNATIVE SOURCES OF WATER FOR PROTOTYPE OIL SHALE DEVELOPMENT COLORADO AND UTAH

September 1974

BUREAU OF RECLAMATION
UPPER COLORADO REGION
SALT LAKE CITY, UTAH

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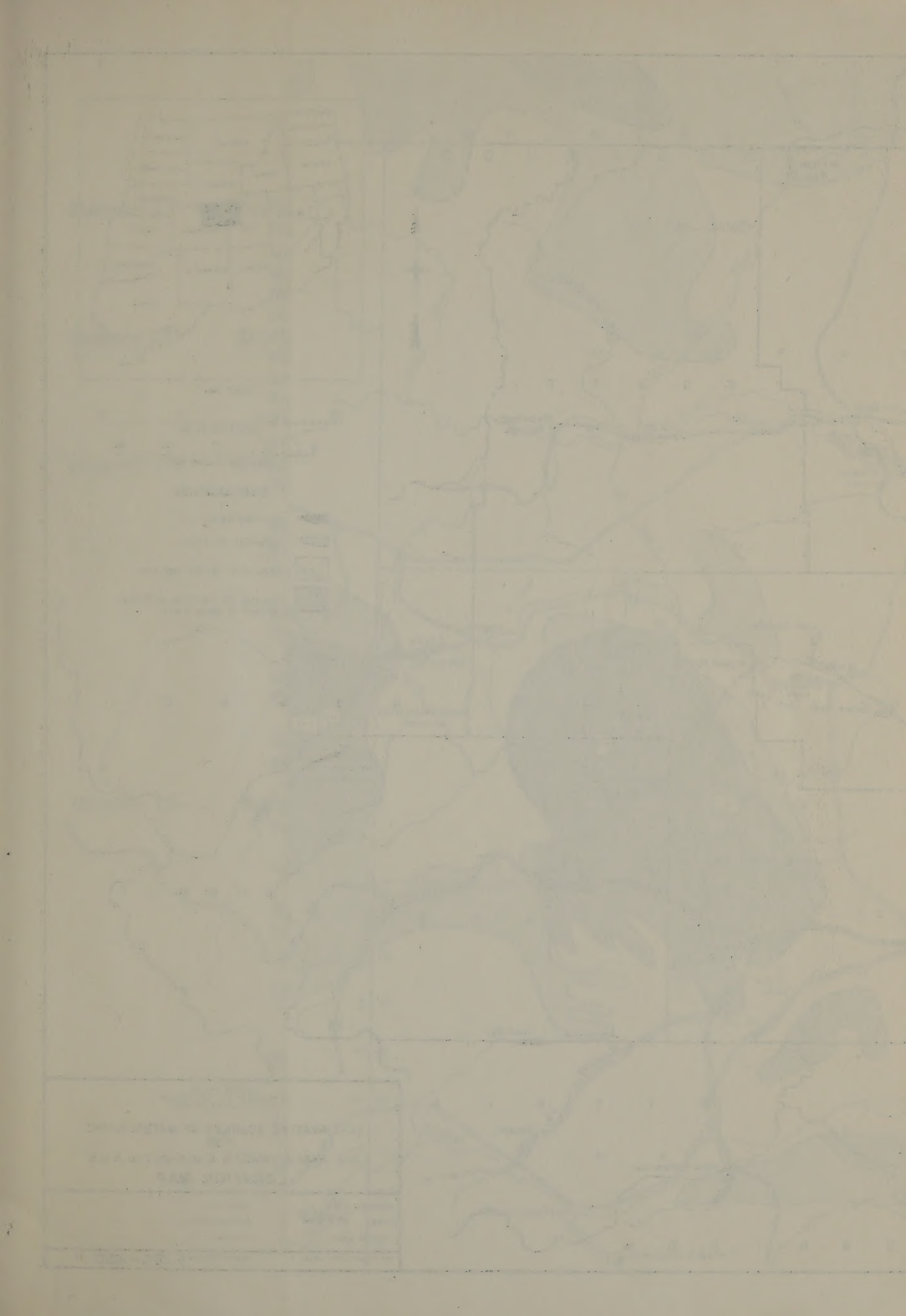

Flaming Gorge Reservoir
WYOMING
COLORADO
SUMMIT
DAGGETT
MOFFAT
ROUTT
Pot Hook Res.
Slater Pk.
Moon Lake
Uinta R.
Lake Fork Cr.
Tyzack Res.
Ashley Cr.
Brush Cr.
Steinaker Res.
Vernal
Green River
Little Snake River
Yampa River
Craig
Juniper Reservoir
Elk River
Steamboat Springs
Trout Cr.
Duchesne
Starvation Res.
Duchesne River
UINTAH
DUCHESNE
Bonanza Municipal Res.
Bonanza
White River
Watson Res.
Rangely
Hells Hole Canyon Reservoir
U-a
U-b
UTAH OIL SHALE TRACTS
Yellow Creek Reservoir
Yellow Cr.
RIO BLANCO
C-a
COLORADO OIL SHALE TRACTS
C-b
Piceance Cr.
Meeker
Powell Park
Lost Park Res.
Ripple Res.
Buford Res.
White River
South Fk.
Kremmling
Blue River
GRAND
Green Mountain Reservoir
CARBON
RIVER
GARFIELD
Rifle
Grand Valley
Una Res.
Glenwood Springs
Colorado River
EAGLE
SUMMIT
Ruedi Res.
Roaring Fk.
PITKIN
Aspen
EMERY
GREEN RIVER
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COLORADO RIVER
MESA
GRAND JUNCTION
Gunnison R.
Dominguez Reservoir
Placita Reservoir
GUNNISON

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10 0 10 20
SCALE OF MILES
10 0 10 20 30
SCALE OF KILOMETERS

EXPLANATION

- Existing Reservoir
- Potential Reservoir
- Area of Oil Shale Deposits
- Area of 25 Gal/Ton or Richer 10 Feet or More Thick

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

ALTERNATIVE SOURCES OF WATER SUPPLY FOR OIL SHALE TRACTS C-a, C-b, U-a & U-b
LOCATION MAP

DESIGNED ..... SUBMITTED .....
DRAWN ..... RECOMMENDED .....
CHECKED ..... APPROVED .....
SALT LAKE CITY, UTAH AUGUST 21, 1974 OS-400-1

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CHAPTER I

INTRODUCTION

Purpose of Report

This report has been prepared by the Bureau of Reclamation to identify specific alternative sources of water for use in prototype oil shale developments in Tracts C-a and C-b in west-central Colorado and Tracts U-a and U-b in east-central Utah. Lease sales for these tracts have been accepted from private companies by the Secretary of the Interior. The leasing companies are now firming up their plans for mining and processing oil shale from the tracts, including a determination of the most desirable source of the required water supplies.

The report has been prepared for submittal to the Oil Shale Environmental Advisory Panel at its September 10, 1974, meeting at Laramie, Wyo. It is intended to provide technical information on alternative water sources for consideration and examination by the panel before it makes recommendations on water developments for oil shale to the Secretary of the Interior. It is anticipated that information in the report will be considered along with the interests of the States of Colorado and Utah and of industry and various environmental and socio-economic factors.

Because of time deadlines imposed, the plans outlined in this report are the result of only cursory study by the Bureau of Reclamation. No extensive involvement of other Federal agencies, the States, nor the

public has been possible. However, the Geological Survey and Fish and Wildlife Service were contacted and did provide input relating to ground water resources in the area and recommended flows for fish within the area of study, particularly in the Lower White River drainage basin. It is understood that Colorado and Utah have indicated a willingness to devote part of their unused Colorado River entitlement to development of the prototype leases.

Before any of the plans outlined in this report could be recommended for construction, additional studies would be necessary. These would include geologic studies, more complete hydrologic studies, environmental impact studies, more detailed designs and estimates, and financial and economic studies. The contents of the report will be brought before the public to obtain their thoughts and reaction if desired. Actual construction of a project under any one of the development plans could not proceed until an environmental impact statement on the project had been completed in accordance with the National Environmental Policy Act of 1969 (83 Stat. 852).

The information contained in this report is based on and supplements information presented in previous reports by the Department of Interior on oil shale development. The principal reports include the July 1974 report on Water for Energy in the Upper Colorado River Basin, which was prepared by the Water for Energy Management Team in Denver, Colo., and a Final Environmental Impact Statement of 1973 on the Prototype Oil Shale Leasing Program, which was prepared by the Oil Shale Task Force.

Location

All four of the leased oil shale tracts are in the drainage basin of the White River, which is a tributary of the Green River, in turn a tributary of the Colorado River. Tracts C-a and C-b are in the Piceance Basin. Tract C-a is in the drainage of Yellow Creek, a tributary of the White River. This tract has been leased to Standard Oil Company of Indiana and Gulf Oil Corporation for $210,305,600. Tract C-b is in the drainage area of Piceance Creek, also a tributary of White River. This tract has been leased for $117,778,000 to a consortium consisting of Atlantic Richfield Company, Shell Oil Company, the Oil Shale Corporation, and Ashland Oil Company. Tracts U-a and U-b are side by side south of the White River. The White River runs through the northern edge of each tract. Tract U-a has been leased for $75,596,000 to Phillips Oil Company and Sun Oil Corporation. Tract U-b has been leased for $45,107,200 to White River Shale Oil Corporation which is made up of Sohio Petroleum Company, Phillips Petroleum Company, and Sun Oil Company.

Present plans of the oil companies provide for a 300,000-barrel per day (bpd) production at Tract C-a and a 100,000-bpd production at Tract C-b. Combined operations are planned for Tracts U-a and U-b with production of 100,000 bpd.

Water Requirements

Water requirements for prototype operations at the four tracts are presently estimated at an average of 111,000 acre-feet annually. Requirements by tracts are shown on the following page.

	Production (bpd)	Annual water requirements (acre-feet)
Tract C-a	300,000	57,000
Tract C-b	100,000	18,000
Tracts U-a and U-b	100,000	36,000
		111,000

As a result of new information from the leasing companies, the water requirements as shown above differ somewhat from those outlined in the July 1974 Report on Water for Energy. The leasing companies for Tract C-a now estimate their mining and retorting processes will require about 57,000 acre-feet annually rather than 52,000 acre-feet shown in the July report. The leasing companies for Tracts U-a and U-b estimate that their requirement will be 36,000 acre-feet annually instead of the 9,000 acre-feet shown in the July report. Of the additional 27,000 acre-feet, 9,000 acre-feet will be required for a doubling of production to 100,000 bpd from the 50,000 bpd shown in the July report, and the remaining 18,000 acre-feet has been requested for a new town which the leasing companies now plan in the vicinity of Bonanza, Utah, for the personnel who will service their operations. The requirements now estimated for Tract C-b are the same as those outlined in the July report. No new towns are planned in the vicinity of the Colorado tracts.

Availability of Water

Estimated usable supplies

The July 1974 report on Water for Energy estimated future water needs of the Upper Colorado River Basin to the year 2000, including the needs for energy development, which include the needs for oil shale

Tracts C-a, C-b, U-a, and U-b. It gave reasonable assurance that water would be available for planned and projected energy developments in the Upper Colorado River Basin provided certain State and Federal actions are taken. According to that report, current estimates of total usable supply for the upper basin range from about 5.8 to 6.5 million acre-feet. The amount of water presently being consumptively used in the basin is approximately 3.7 million acre-feet a year. Thus on the conservative basis of a 5.8-million-acre-foot supply, approximately 2.1 million acre-feet are not being utilized at present. In Colorado and Utah, where the prototype oil shale developments are planned, the unused supplies are estimated at 852,000 and 497,000 acre-feet, respectively. The following tabulation shows the estimates of supplies for Colorado and Utah, based on the assumption of a total 5.8-million-acre-foot supply for the upper basin.

	(Thousand acre-feet)	
	Colorado	Utah
Usable supply	2,976	1,322
1974 depletions	2,124	825
Unused supply	852	497

The July 1974 report points out that certain actions are required to make water in the Upper Colorado River Basin available to meet the estimated future needs, including (1) strong State leadership in the resolution of water rights and water allocation questions and the attainment of efficiency in water use, (2) construction of additional storage facilities, and (3) subsequent action to increase water supplies through weather modification or other means to provide for these and other related water demands. Many uses compete with oil shale for the unused

supply of water. These include domestic uses, agriculture, power generation, coal gasification and liquification, municipal and other industrial uses, fisheries and other recreational uses.

Sources of supply

The most desirable means for providing water to the oil shale tracts appears to be an importation by pipeline of high quality water from the White, Green, or Colorado River. As later discussed, some possibilities exist for ground water development in the vicinity of the oil shale tracts in Colorado but there are only very limited possibilities for such development in Utah and local surface supplies are limited in both Colorado and Utah.

The tributaries of Piceance Creek carry water only during periods of snow melt or following heavy rain or thunder showers. The mean flow of Piceance Creek at White River, Colo., 1.3 miles upstream from the confluence of the streams is about 17 second-feet (about 12,000 acre-feet a year), with the flow fluctuating from 300 second-feet to 0.50 second-foot. Diversions are made above the gaging station for the irrigation of about 5,000 acres of land. Fresh water is present in the alluvium along Piceance Creek and its longer tributary valleys. Prior water rights and Colorado water law, however, would limit development and use of alluvial water without replacement or compensation to present users. Yellow Creek and tributaries in the vicinity of Tract C-a, primarily Corral Gulch and Box Elder Gulch, do not sustain streamflow except during periods of snowmelt and thunder storms.

Local tributaries of the White River which are within the area of the Utah oil shale tracts drain relatively low-elevation watersheds that receive small amounts of precipitation each year. Streamflow is intermittent and very limited in amount. The ground water supply in the vicinity of the Utah oil shale tracts is so small that it would not support a significant oil shale industry.

Bases for Analyses

Appraisal level designs and estimates have been made for use in determining the specific features to be used in the alternative plans outlined in this report. It has been assumed that all pipelines would be buried and all pumping plants would be winterized for year-round delivery of water. It has also been assumed that all pumping plants would be semi-attended during operation.

Costs of construction, including costs of rights-of-way, materials, labor, engineering overhead, and contingencies, are based on January 1974 prices. Interest during construction has been taken as a flat 12 percent of the construction costs on the assumption that the construction costs would be spread on a straight-line basis over a 4-year period at 6 percent interest. Estimates have been made of annual operating costs, including costs for purchase of water, purchase of power for pumping, and operation, maintenance, and replacement costs. Costs for water purchase have been estimated only for developments that would obtain water from reservoirs that have been constructed or that are in the advance planning stage of investigations. No estimates have been made of the

Local tributaries of the Rio Grande River which are within the area of the Llano oil shale tract contain relatively low-mineralized waterbeds that receive small amounts of precipitation each year. Streamflow is intermittent and very limited in amount. The ground water supply in the vicinity of the Llano oil shale tract is so small that it would not support a significant oil shale industry.

Plans for Analyses

Appraisal level designs and estimates have been made for use in determining the specific features to be used in the alternative plans outlined in this report. It has been assumed that all pipelines would be buried and all pumping plants would be electrified for year-round delivery of water. It has also been assumed that all pumping plants would be semi-attended during operation.

Costs of construction, including costs of rights-of-way, materials, labor, engineering overhead, and contingencies, are based on January 1974 prices. Interest during construction has been taken as a flat 12 percent of the construction costs on the assumption that the construction costs would be spread on a straight-line basis over a 5-year period at 6 percent interest. Estimates have been made of annual operating costs, including costs for purchase of water, purchase of power for pumping, and operation, maintenance, and replacement costs. Costs for water projects have been estimated only for developments that would obtain water from reservoirs that have been constructed or that are in the advance planning stage of investigations. No estimates have been made of the

costs that would be incurred in the purchase of senior direct flow rights and their conversion for oil shale development. All of the alternatives outlined except one would require the use of large amounts of electrical energy. It has been assumed for the report that the power required for pumping would be obtained from private utilities. Some lessees, however, have indicated that they would use process gas to generate their own electrical energy. The estimated costs for purchase of power are based on rates of 1 cent a kilowatt-hour for energy and $1.50 per kilowatt per month for demand.

As a basis for comparisons of the alternative plans, estimates have been made of the annual costs of each plan, including the annual equivalent of the construction cost and interest during construction as well as the annual operating costs. Significant public involvement has been assumed in the estimates of annual equivalent costs, and these are based on 6 percent interest and a 40-year payment period.

CHAPTER II

EXISTING RESERVOIRS

Five existing reservoirs in Colorado and Utah have been considered as sources for water for the oil shale industry. They are Blue Mesa, Green Mountain, and Ruedi Reservoirs in Colorado and Flaming Gorge and Starvation Reservoirs in Utah.

Blue Mesa Reservoir

Blue Mesa Reservoir, a feature of the Curecanti Unit of the Colorado River Storage Project, is located southeast of Grand Junction on the Gunnison River. As much as 200,000 acre-feet of water could be made available from the reservoir for municipal and industrial purposes. If the water were used for Tracts C-a and C-b, it would be released to the Gunnison River and allowed to flow 100 miles to the confluence of the river with the Colorado River at Grand Junction. From this point it would have to be pumped a vertical distance of approximately 4,000 feet and conveyed a distance of 55 miles over the Bookcliffs to Tracts C-a and C-b. The cost of purchasing water from Blue Mesa Reservoir would be subject to negotiation, but it is estimated that it would range from $7 to $15 an acre-foot. The water users would have to provide facilities at the diversion point for removal of the sediment load as well as pumping and conveyance facilities. Additional costs would be required for power for pumping. The costs of the development would be prohibitive in comparison with costs of water from other sources.

CHAPTER II

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Five existing reservoirs in Colorado and Utah have been considered as sources for water for the oil shale industry. They are Blue Mesa, Green Mountain, and Ruedi Reservoirs in Colorado and Flaming Gorge and Starvation Reservoirs in Utah.

Blue Mesa Reservoir

Blue Mesa Reservoir, a feature of the Curecanti Unit of the Colorado River Storage Project, is located southeast of Grand Junction on the Gunnison River. As much as 830,000 acre-feet of water could be made available from the reservoir for municipal and industrial purposes. If the water were used for Tracts C-a and C-b, it would be released to the Gunnison River and allowed to flow 100 miles to the confluence of the river with the Colorado River at Grand Junction. From this point it would have to be pumped a vertical distance of approximately 8,000 feet and conveyed a distance of 55 miles over the Roubaix to Tracts C-a and C-b. The cost of producing water from Blue Mesa Reservoir would be subject to negotiation, but it is estimated that it would range from $7 to $15 an acre-foot. The water users would have to provide facilities as the diversion point for removal of the sediment load as well as pumping and conveyance facilities. Additional costs would be required for power for pumping. The costs of the development would be prohibitive in comparison with costs of water from other sources.

Although Blue Mesa Reservoir water could not practicably be used in Tracts C-a and C-b, it could be used to increase the municipal supply for Grand Junction to meet the anticipated population growth associated with industry in that city and surrounding area.

The United States and the Colorado River Water Conservation District own decrees covering 940,755 acre-feet of storage in Blue Mesa Reservoir with a November 13, 1957, priority.

Green Mountain Reservoir

Green Mountain Reservoir, a feature of the Colorado River-Big Thompson Project, is located on the Blue River approximately 12 miles south of the river's confluence with the Colorado River. It has a capacity of 152,000 acre-feet, all for use on the western slope. This capacity includes 52,000 acre-feet for replacement in western Colorado of water diverted by the Colorado-Big Thompson Project. The remaining 100,000 acre-feet is for power purposes and is available to supply existing and future irrigation and domestic purposes. Approximately 49,700 acre-feet of this capacity is presently covered by options and rights. The remaining capacity, amounting to 50,300 acre-feet, is not presently available for sale as there is an active slide within the reservoir basin and the Bureau of Reclamation, which operates the reservoir, is reluctant to permit further drawdown of the reservoir until the potential effects of the slide can be further evaluated.

Existing options for use of Green Mountain Reservoir water include 7,200 acre-feet for Atlantic Richfield Oil Company and 18,000 acre-feet for Carter Oil Company. As nearly as can be determined at this time, there has been no commitment of any of this water to the development of Tract C-a or C-b. The remaining capacity in the reservoir is covered by rights for existing irrigation projects, including 5,000 acre-feet for the Silt Project and 19,500 acre-feet for the Grand Valley Project.

The United States owns a decree dated August 1935, covering the 152,000 acre-feet of storage in Green Mountain Reservoir.

The water released from Green Mountain Reservoir and diverted from the Colorado River near Rifle, Colo., would have an average concentration of total dissolved solids of about 500 mg/l.

Ruedi Reservoir

Ruedi Reservoir, a feature of the Fryingpan-Arkansas Project, is located on the Fryingpan River approximately 30 miles southeast of Glenwood Springs. Present estimates indicate that at least 30,000 acre-feet of water could be available from this reservoir for oil shale development. Alternatives for making the water available are discussed in the following chapter under potentialities for pumping from the Colorado River to Tract C-a shown on pages 25 and 43.

The cost of water at Ruedi Reservoir is estimated at about $15 an acre-foot, but the actual cost would be subject to negotiation. In addition costs would be incurred for construction of the pumping and conveyance facilities as well as for electrical energy for pumping.

Gulf Mineral Resources Company, representing Gulf Oil Corporation and Standard Oil Company of Indiana, is presently negotiating for 30,000 acre-feet of water from Ruedi Reservoir for use in 1980.

The Colorado River Water Conservation District owns a conditional decree with a priority date of July 29, 1957, covering 140,697 acre-feet of storage in Ruedi Reservoir.

Water released from Ruedi Reservoir and diverted from the Colorado River near Rifle, Colo., would have an average concentration of total dissolved solids of about 500 mg/l.

Flaming Gorge Reservoir

Development plan

Flaming Gorge Reservoir, constructed as a feature of the Colorado River Storage Project, is located on the Green River in northeastern Utah and southwestern Wyoming. It is approximately 70 air miles north of Tracts U-a and U-b.

A water supply of about 500,000 acre-feet annually could be made available in Flaming Gorge Reservoir for various uses. The 36,000 acre-feet of water required for Tracts U-a and U-b and the new town planned in the vicinity of Bonanza could be made available from this supply. The water would be released from the reservoir into the Green River. It would continue in the river about 80 miles to a point about 5 miles downstream from the Ashley Creek confluence where it would be pumped for conveyance to the oil shale area. The water would be provided from the reservoir in a continuous flow of 50 second-feet.

Locations of facilities in the development plan are shown on the map on page 18.

Project features

Construction features required to provide the water to the oil shale area would include three pumping plants, 23.2 miles of 39-inch-diameter concrete pipe, 3.8 miles of 27-inch-diameter concrete pipe, and a 6,000-acre-foot reservoir for regulation of the flows.

Pumping Plant No. 1 would be located on the south bank of the Green River. It would have a rated capacity of 50 second-feet and a dynamic

head of 578 feet. An intake channel and riprap protection would be required on the river. The discharge line would consist of 4.4 miles of 39-inch reinforced concrete pipe. The flows would discharge into an equalizing reservoir at the intake of Pumping Plant No. 2.

Pumping Plant No. 2, with a dynamic head of 447 feet, would lift 50 second-feet from the equalizing reservoir. The discharge line would consist of 18.8 miles of 39-inch reinforced concrete pipe. The flows would be discharged into a small regulatory reservoir near the town of Bonanza. This reservoir would have a total capacity of 6,000 acre-feet, with 4,000 acre-feet of active capacity. Flows would be regulated to meet the use pattern required at the community and the oil shale tracts.

Pumping Plant No. 3 with a rated capacity of 25 second-feet and a dynamic head of 185 feet would pump water from the reservoir to a ridge overlooking the lease tracts. The discharge line would consist of 3.8 miles of 27-inch reinforced concrete pipe. It would convey the flows from the pumping plant to a point south across the White River near the Ignatio Stage site and at about elevation 5,560 in Utah Tract U-b.

Power for pumping could be obtained from an existing 69-kilovolt powerline that extends within a quarter mile of the pumping plant sites.

Estimated costs

The capital costs of the pumping development are estimated at $27,245,000, including $24,325,000 for construction and $2,920,000 for interest during construction. The annual equivalent of these costs is estimated at $1,811,000. The annual operating costs are estimated at $1,244,700. These annual costs include $360,000 for purchase of water,

$735,900 for purchase of power, and $148,800 for operation, maintenance, and replacements. The sum of the estimated annual equivalent cost and the annual operating cost is $3,055,700 or $85 an acre-foot. Costs for water purchase are based on $10 an acre-foot but the actual cost would be subject to negotiation. The power costs are based on the purchase of 60,090,000 kilowatt-hours of energy and a maximum demand capacity of 13,320 kilowatts.

Water supply

A contract for use of water from Flaming Gorge Reservoir, including the purchase price, is subject to negotiation.

The quality of the water from Green River is good enough for domestic and municipal uses. At the point of diversion into the conveyance system the content of dissolved solids averages about 430 mg/l and ranges from about 130 to 650 mg/l.

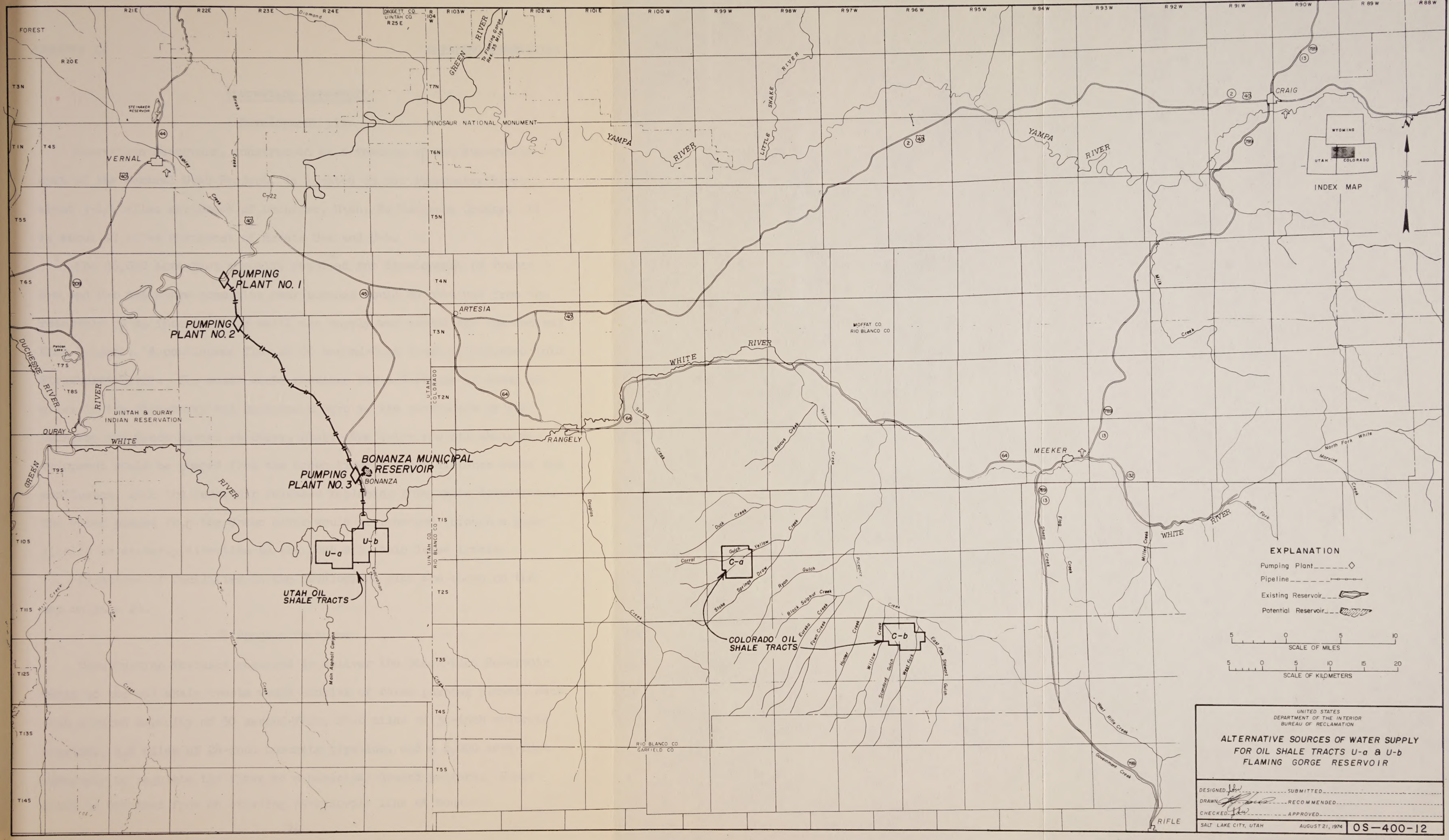
The diversion from the Green River of 36,000 acre-feet annually would result in a depletion of 24,000 acre-feet from the river system. As a result of the depletion the salinity of the Colorado River at Imperial Dam would be increased by about 1.5 mg/l.

The Bureau of Reclamation owns Water Right Application No. 30414, which has a priority date of August 7, 1958. This application covers the storage of 4 million acre-feet of the flows of the Green River in Flaming Gorge Reservoir, including 500,000 acre-feet for use on the Central Utah Project and the balance for power generation and river regulation.

Environmental effects

The impacts of the development on the Flaming Gorge Reservoir area would be minimal. Releases of 50 second-feet on a continuous basis would enhance the fishery flows in the river from the dam to the point of pumping on the river, a river distance of about 80 miles.

The pumping plants, pipelines, and associated features would traverse an area of sparse desert shrubs and grasses. The pipeline alinement would be adjacent to an existing unsurfaced road that extends about 23 miles from the site of the first plant to Bonanza. Some grading and surfacing of the road would be required to assure all-weather access to the pumping plants and pipelines. The 69-kilovolt powerline that could be used as a source of electrical energy for pumping traverses this same alinement. Additional impacts along the alinement would result mainly from construction of the underground pipeline, pumping plants, and a regulatory reservoir near Bonanza. Each pumping plant would require about 15 acres, and all of this land would be permanently affected. The pipeline construction would disturb about 200 acres during the construction period, with most of the land being restored and reseeded. The reservoir near Bonanza would inundate about 220 acres at maximum water surface elevation 5,399.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PUMPING PLANT NO. 2
PUMPING PLANT NO. 3
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BONANZA
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U-b
UTAH OIL SHALE TRACTS
C-a
C-b
COLORADO OIL SHALE TRACTS
VERNAL
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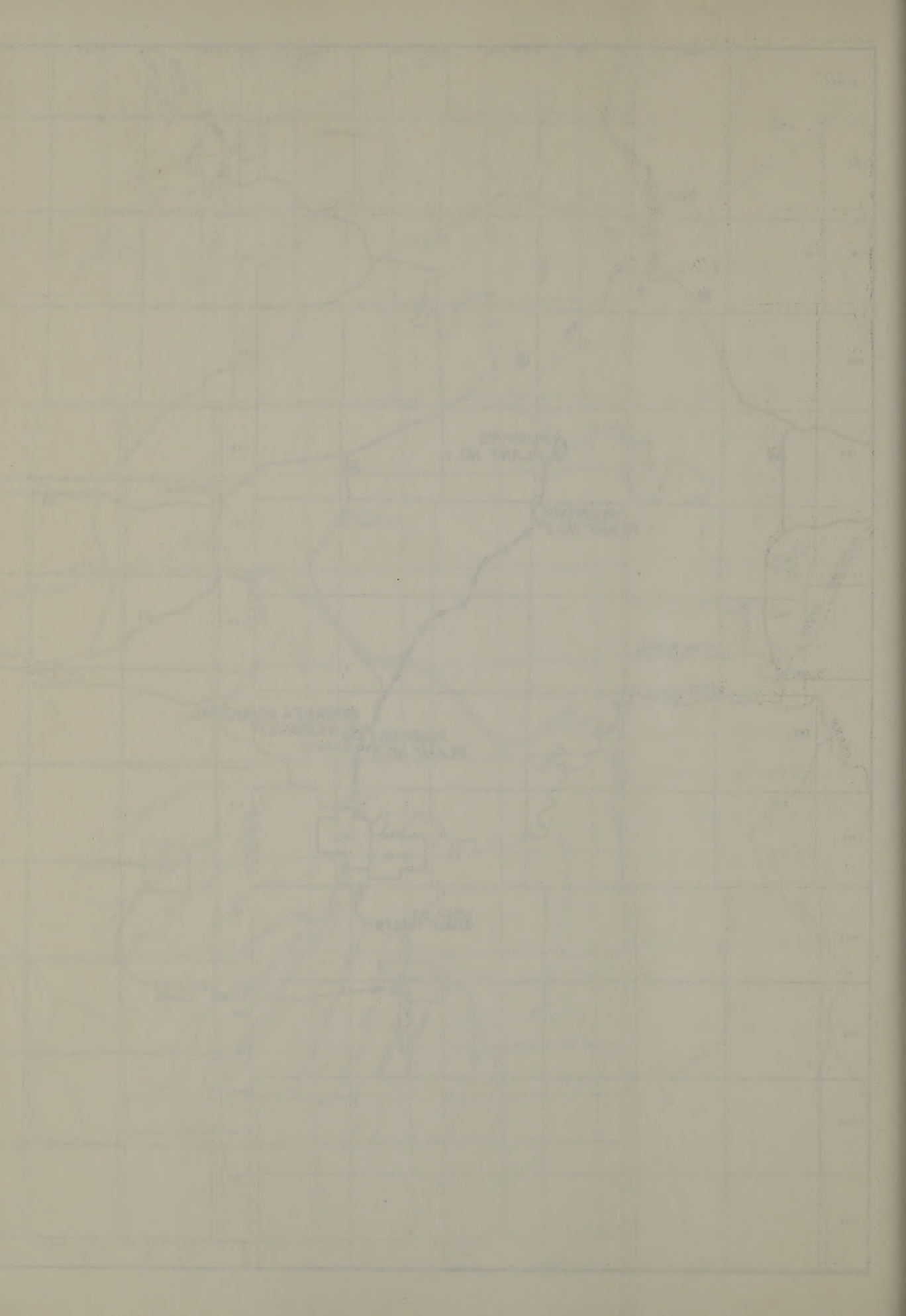


Starvation Reservoir

Development plan

Starvation Reservoir, constructed as a feature of the Bonneville Unit of the Central Utah Project, is located on the Strawberry River about 3-1/2 miles northwest of Duchesne, Utah, in Duchesne County. It is about 70 miles northwest of Tracts U-a and U-b.

The 36,000 acre-feet annually required for development of Tracts U-a and U-b and a new community near Bonanza could be obtained from the reservoir on an interim basis until the supply was needed for the Central Utah Project. A continuous flow of 50 second-feet would be released into Strawberry River. The water would continue for a distance of about 40 miles in the Strawberry and Duchesne Rivers to the confluence of the Duchesne and Green Rivers at Ouray, Utah. The water for oil shale development would be pumped from the Green River a short distance above the confluence, with the reservoir releases replacing this water downstream. The water pumped from the Green River would be conveyed through a pipeline in an easterly direction to the Utah oil shale lease tracts.

Locations of facilities in the development plan are shown on the map on page 24.

Project features

Construction features required to deliver the Starvation Reservoir water to the oil shale tracts would consist of three pumping plants, each with a rated capacity of 50 second-feet, 28.8 miles of 36-inch concrete pipeline, 3.6 miles of 24-inch concrete pipeline, and a 6,000 acre-foot reservoir to regulate the flows to a municipal demand pattern. Power could be obtained from an existing 69-kilovolt line at Bonanza.

Pumping Plant No. 1 on the Green River would have a total dynamic head of 556 feet. About 30 miles of new power transmission line would be required from the line at Bonanza. The discharge line from the pump would be a 36-inch reinforced concrete pipe 15.6 miles long. It would be buried and the alinement would parallel an existing pipeline and unsurfaced road. The road would require some grading and surfacing to make access possible throughout the year. The flows would discharge in an equalizing reservoir at the intake of Pumping Plant No. 2.

Pumping Plant No. 2 would have a total head of 499 feet. The powerline to Plant No. 1 would also serve Plant No. 2. Access to this plant would also be from the existing road. The discharge line for Plant No. 2 would be a 36-inch reinforced concrete pipeline 7.1 miles long. The flows would discharge into an equalizing reservoir at the intake to Plant No. 3.

Pumping Plant No. 3 would have a total head of 498 feet. Power and access would be provided by the same facilities used for the other plants. Pumping Plant No. 3 would lift the flows to the top of a ridge through a 6.1-mile long discharge line of 36-inch reinforced concrete pipe. At this point water would be delivered to two 24-inch concrete lines, each with a capacity of 25 second-feet. One would extend a distance of 1.3 miles to the municipal reservoir at Bonanza and the other a distance of 2.3 miles to the south side of the White River in Tract U-b.

Estimated costs

The capital costs of the pumping development are estimated at $32,170,000, including $28,720,000 for construction and $3,450,000 for

interest during construction. The annual equivalent of these costs is estimated at $2,138,000. The annual operating costs are estimated at $3,255,000. These annual costs include $1,980,000 for purchase of water, $1,105,400 for purchase of power; and $169,600 for operation, maintenance, and replacements. The sum of the estimated annual equivalent cost and the annual operating cost is $5,393,000 or $150 an acre-foot. Costs for water purchase are based on $55 an acre-foot but the actual price of the water would be subject to negotiations. The power costs are based on the purchase of 91,770,000 kilowatt-hours of energy and a maximum demand capacity of 9,500 kilowatts.

Water supply

The water supply from Starvation Reservoir could be made available to the oil shale development only for an interim term of 10 to 15 years when it would be needed for planned purposes of the Central Utah Project. At the end of this period another water supply would have to be obtained by the oil shale tract lessees. This interim period, however, would give the developers time to acquire a permanent water supply.

The use of the water from Starvation Reservoir would be subject to negotiation.

The quality of the water in the Duchesne River is poor at some times of the year, with the total dissolved solids ranging from 200 to 3,300 mg/l. Since the water would be made available from the Green River by exchange, however, the quality of the water used would have a content of total dissolved solids of about 450 mg/l and would be considered good

enough for municipal use. The total dissolved solids would range from 150 to 700 mg/l in the Green River at the diversion point.

It is anticipated that the Colorado River would be depleted by about 24,000 acre-feet annually. As a result of the depletion the salinity of the river at Imperial Dam would be increased by about 1.5 mg/l. Per acre-foot diversions from Starvation Reservoir for oil shale development would have the same effect on the salinity of the Colorado River system as the Bonneville Unit but the effects would be realized at an earlier date.

Water rights

The water rights for Starvation Reservoir water are included with the rights for the Bonneville Unit, Central Utah Project. These were filed by the Bureau of Reclamation and include Application No. 18043 dated September 4, 1946, Application No. 36638 dated November 19, 1964, and Application No. 36639 dated November 19, 1964.

Environmental effects

The water supply obtained from Starvation Reservoir would have minimal impacts on the area around the reservoir in addition to those already caused by construction of the dam and reservoir. Releases made from the reservoir would enhance the river flows for fishery from the dam to Pumping Plant No. 1, a distance of about 40 miles.

The pipeline would traverse an area along the north side of the White River from the mouth of the river to Bonanza. The area is vegetated with sparse desert shrubs and grasses. An existing road and a gas pipeline traverse the alinement that would be followed by the

pipeline. A new powerline from Bonanza could also follow this same route. The pipeline and powerline would disturb about 320 acres of land during construction, with about 150 acres affected permanently. Each of the three pumping plants would require about 15 acres, and all of this land would be affected permanently. The municipal reservoir at Bonanza would inundate about 220 acres at maximum water surface elevation.

PUMPING PLANT NO. 1

PUMPING PLANT NO. 2

PUMPING PLANT NO. 3

BONANZA MUNICIPAL RESERVOIR

BONANZA

VERNAL

ARTESIA

CRAIG

MEEKER

RANGELY

RIFLE

OURAY

DINOSAUR NATIONAL MONUMENT

UINTAH & OURAY INDIAN RESERVATION

UTAH OIL SHALE TRACTS

U-a

U-b

COLORADO OIL SHALE TRACTS

C-a

C-b

GREEN RIVER

YAMPA RIVER

WHITE RIVER

DUCHESNE RIVER

SNAKE RIVER

LITTLE SNAKE RIVER

DAGGETT CO.
UINTAH CO.

MOFFAT CO.
RIO BLANCO CO.

RIO BLANCO CO.
GARFIELD CO.

UINTAH CO.
RIO BLANCO CO.

UTAH
COLORADO

INDEX MAP

WYOMING
UTAH
COLORADO

EXPLANATION

Pumping Plant

Pipeline

Existing Reservoir

Potential Reservoir

SCALE OF MILES
5 0 5 10

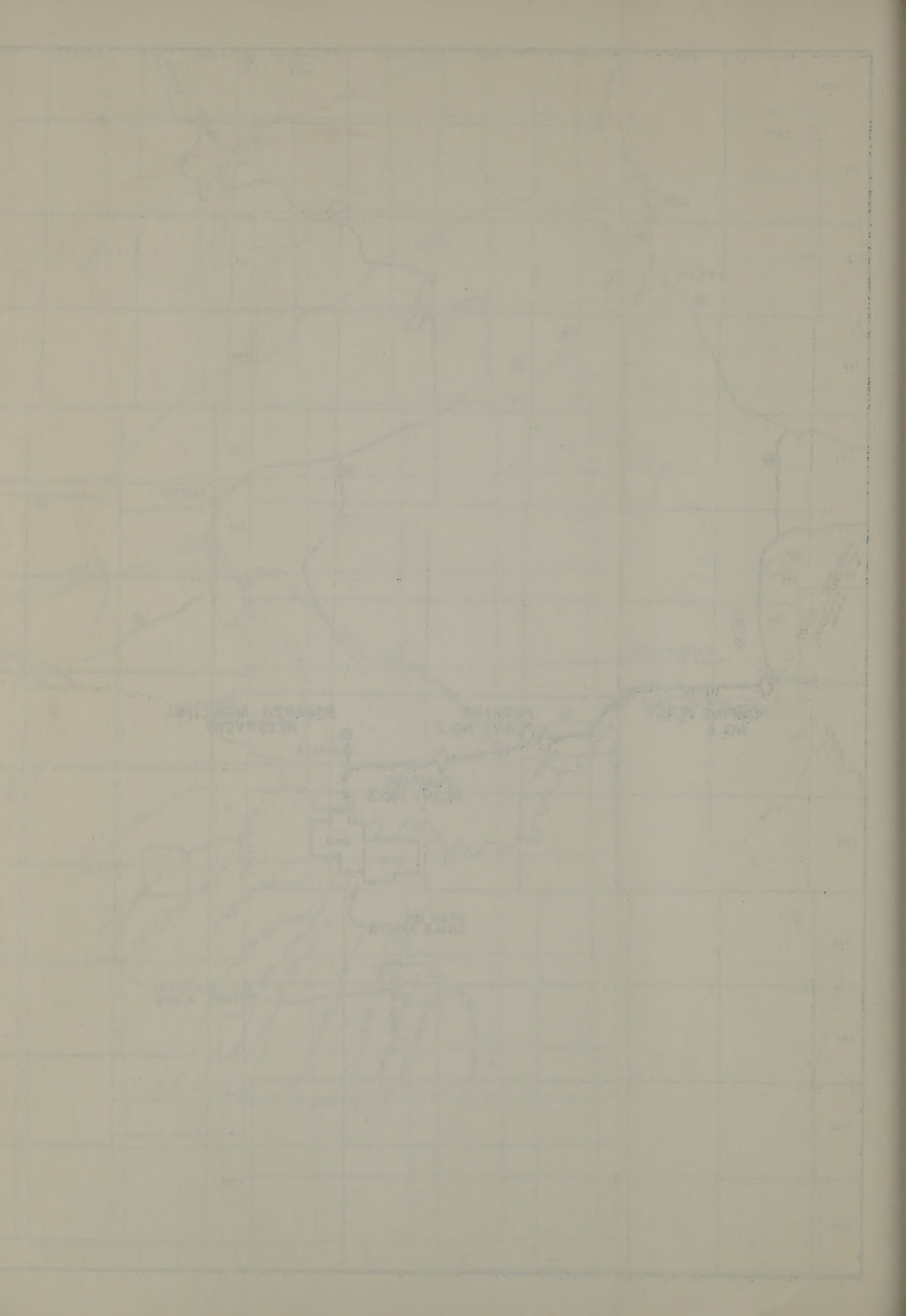
SCALE OF KILOMETERS
5 0 5 10 15 20

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

ALTERNATIVE SOURCES OF WATER SUPPLY
FOR OIL SHALE TRACTS U-a & U-b
STARVATION RESERVOIR

DESIGNED JW SUBMITTED
DRAWN D Montoya RECOMMENDED
CHECKED JW APPROVED

SALT LAKE CITY, UTAH AUGUST 21, 1974 OS-400-16



CHAPTER III

SINGLE-PURPOSE DEVELOPMENTS

Pumping from Colorado River for Tract C-a.

Development plan

The 57,000 acre-feet of water required for Tract C-a could be obtained by pumping from the Colorado River. The lessees of Tract C-a are negotiating for an option for the 30,000 acre-feet from Ruedi Reservoir. The remaining 27,000 acre-feet could be obtained by the acquisition of senior irrigation rights in the Colorado River. Locations of features in the plan are shown on the map on page 47.

Project features

Pumping of water from the Colorado River to Tract C-a would require five pumping plants and two pipelines. The first pumping plant would be located on the Colorado River about 4 miles east of the town of Rifle. This plant, along with two booster plants, would lift the water to Piceance Creek. Each pumping plant would have a capacity of 80 second-feet and would pump against a dynamic head of 733 feet. The pipeline from the first pumping plant to its terminus at Piceance Creek would be 23.8 miles long and would have a capacity of 80 second-feet and a diameter of 66 inches. The pipeline would be located generally along Colorado State Highway 13 from Rifle to Piceance Creek. The pipeline would discharge into the stream channel for conveyance downstream to the mouth of Black Sulphur Creek where it would be rediverted and pumped to

Tract C-a. Two pumping plants, each with a dynamic head of 445 feet and a capacity of 80 second-feet, would lift the water to the tract. The pipeline from Piceance Creek to the tract would be 16 miles long and would have a diameter of 66 inches. The pipeline would cross two drainages between Piceance Creek and the tract.

Estimated costs

The capital costs are estimated at $72,580,000, including $64,800,000 for construction and $7,780,000 for interest during construction. The annual equivalent of these costs is estimated at $4,824,000. The annual operating costs are estimated at $3,734,000. These annual costs include $450,000 for purchase of water, $2,985,000 for purchase of power, and $299,000 for operation, maintenance, and replacements. The sum of the annual equivalent cost and the annual operating costs is $8,558,000 or $150 an acre-foot. Costs for water purchase are based on a rate of $15 an acre-foot but this rate is subject to negotiation. The power costs are based on the purchase of 240,000,000-kilowatt-hours of energy and a maximum demand capacity of 32,200 kilowatts.

Water rights

A portion of the water (30,000 acre-feet) could be obtained by contracting for water from Ruedi Reservoir. The balance (27,000 acre-feet) could be made available by acquisition of senior irrigation decrees on the Colorado River to provide a firm supply. No estimates have been made of the costs of acquiring the decrees.

Water quality

The water diverted would be of good quality for municipal and industrial use, with the concentration of dissolved solids ranging from 160 to 930 mg/l. and averaging 500 mg/l. Flows of the Colorado River would be depleted by 57,000 acre-feet annually, and as a result the salinity concentration of the river at Imperial Dam would be increased by about 2.2 mg/l.

Environmental effects

The environmental impacts caused by the pumping development would be minimal. The pipeline from the Colorado River to Piceance Creek would be located along Colorado State Highway 13. The pipeline from Piceance Creek to Tract C-a would traverse an area that is sparsely covered with sagebrush and a semi-arid type ground cover. The area that would be disturbed is about 95 acres in size and after construction it would be reseeded and restored as closely as possible to its natural state.

Yellow Creek Reservoir for Tract C-a

Development plan

A uniform annual water supply of 57,000 acre-feet could be provided to Tract C-a by conveyance of flows from the White River to Yellow Creek and regulation of the flows on the creek at Yellow Creek Reservoir. Features of the plan are shown on the map on page 31.

Project features

Sufficient storage could be constructed on Yellow Creek to provide a continuous water supply during the portions of each year when downstream requirements would limit or preclude diversions from White River to Tract C-a. Active capacity of Yellow Creek Reservoir would be 30,000 acre-feet, with total capacity of 60,000 acre-feet to allow for unusually high sediment inflow. An earth-fill dam about 185 feet high would be constructed. The spillway capacity would be 1,000 second-feet.

A pumping plant located on the White River and a 4.4 mile pipeline would lift surplus flows of the river to the reservoir for regulation. This lift would involve a dynamic head of 425 feet. Capacity of the pumping plant and pipeline would be 250 second-feet. The pipeline would be 78 inches in diameter.

A second pipeline and pumping system would deliver water to Tract C-a from Yellow Creek Reservoir. This system would include two pumping plants with a dynamic head of 607 feet each and 17.6 miles of concrete pipe 66 inches in diameter. The capacity of both the pumping plants and pipeline would be 80 second-feet. The pipeline would closely parallel Yellow Creek.

Estimated costs

The capital costs of development are estimated at $61,490,000, including $54,900,000 for construction and $6,590,000 for interest during construction. The annual equivalent of these costs is estimated at $4,087,000. The annual operating costs are estimated at $1,880,000. These annual costs include $1,691,000 for purchase of power and $189,000 for operation, maintenance, and replacements. The sum of the estimated annual equivalent cost and the annual operating costs is $5,967,000 or $105 an acre-foot. The power costs are based on the purchase of 128,000,000-kilowatt-hours of energy and a maximum demand capacity of 26,500 kilowatts.

Water rights

Gulf Mineral Resources Company filed a water right on Yellow Creek Reservoir on February 20, 1974, which would not provide a firm water supply. It is assumed that the lessees would negotiate with the Yellow Jacket Water Conservancy District and obtain an agreement to use conditional decrees held by the district. These decrees have an early priority and are equal to or senior to most of the large conditional decrees on the White River in Colorado. No estimates have been made of the costs of acquiring the decrees.

Water quality

The water diverted would be of high quality for industrial use. The concentration of total dissolved solids would average about 270 mg/l.

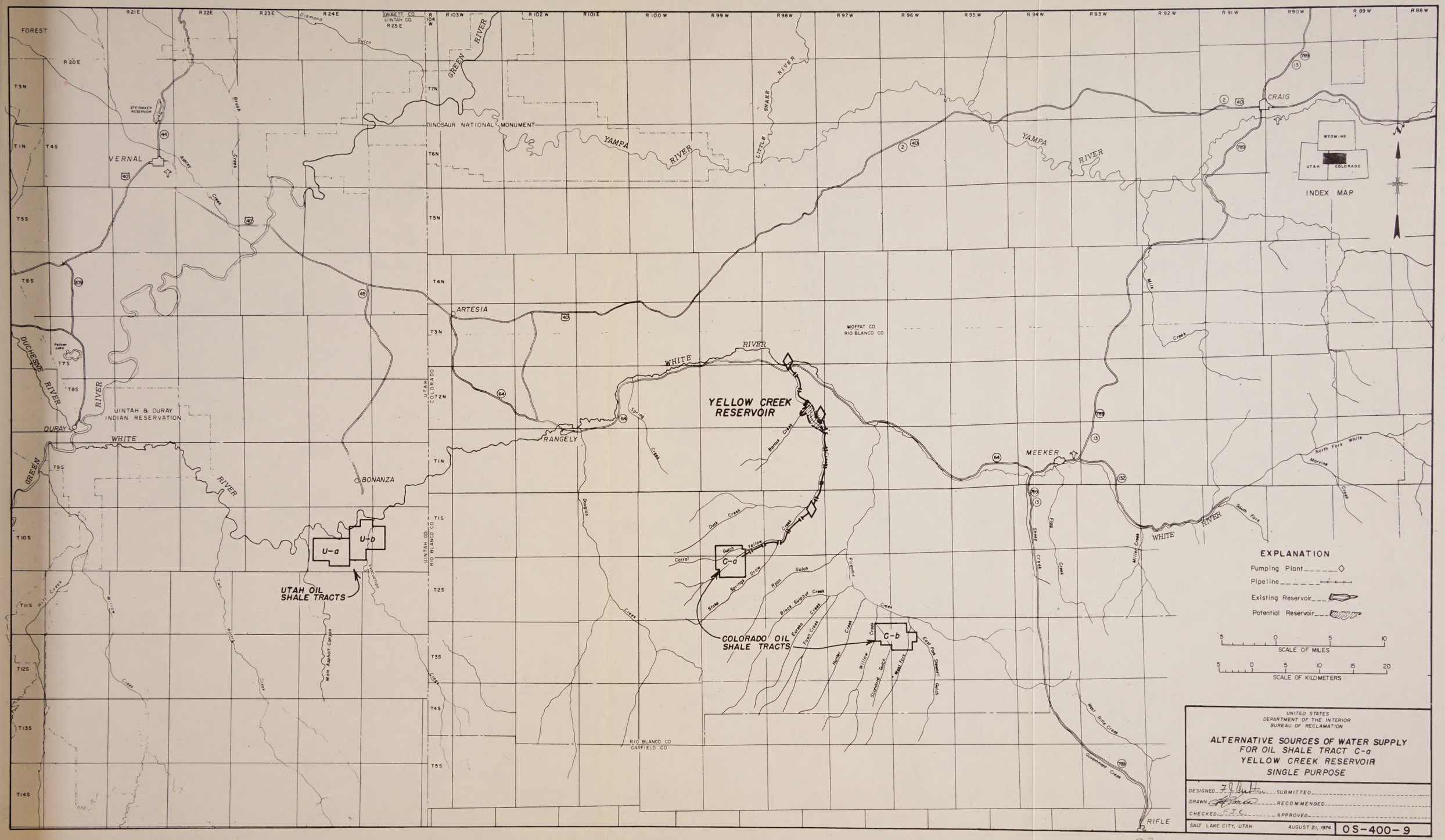
The stream depletion of the Colorado River would be 57,000 acre-feet annually, the same amount as the diversion. This depletion would increase the salinity of the river at Imperial Dam by about 3.9 mg/l.

Environmental effects

The overall environmental effects of the Yellow Creek Reservoir development would not be severe. The most significant effects would probably be those of the reservoir, the dam, and the transmission lines.

Yellow Creek Reservoir would inundate 1,200 acres of land with predominantly sagebrush and greasewood cover. Inundation of this area could cause loss of some habitat for the large deer herd which inhabits the Piceance Basin. The valley is narrow, and the stream (Yellow Creek) is small -- possibly intermittent. There are probably few fish in the stream. Construction of the reservoir would probably necessitate a relocation of the existing road to a higher elevation.

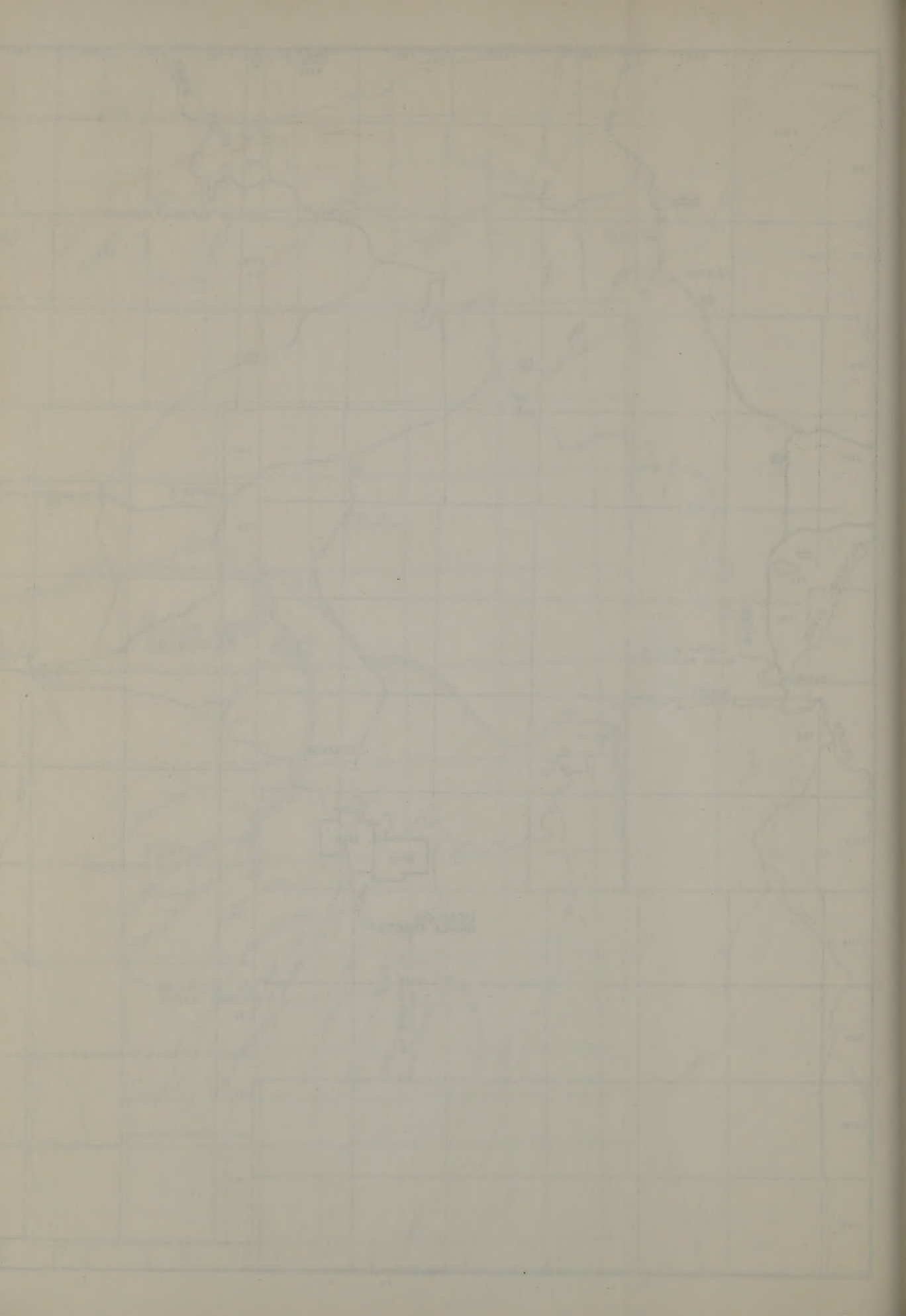
The pipelines would be buried along the present roadway, and after several years no scars on the landscape would remain. The pumping plants and their associated power transmission lines, however, would remain evident.



UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

ALTERNATIVE SOURCES OF WATER SUPPLY FOR OIL SHALE TRACT C-a YELLOW CREEK RESERVOIR SINGLE PURPOSE

DESIGNED	SUBMITTED	
DRAWN	RECOMMENDED	
CHECKED	APPROVED	
SALT LAKE CITY, UTAH — AUGUST 21, 1974		OS-400-9



Ripple Reservoir for Tract C-a

Development plan

Approximately 57,000 acre-feet of water annually could be obtained for Tract C-a by storage at the potential Ripple Reservoir on the North Fork of the White River and diversions of the direct flows of the White River. Locations of facilities needed for the development are shown on the map on page 35.

Project features

Ripple Reservoir could be constructed to a capacity of 18,000 acre-feet (active capacity 17,000 acre-feet). The reservoir would be formed by an earthfill structure approximately 195 feet high. The spillway would have a capacity of 7,600 second-feet. Sediment deposition would be negligible.

Water from Ripple Reservoir would be released to the White River and diverted at a pumping plant on the river at the confluence of Yellow Creek. Two pumping plants would be required to lift water from the river to Tract C-a through a pipeline located along Yellow Creek. The capacity of the two pumping plants and the pipeline would be 80 second-feet. The dynamic head for each plant would be 767 feet. The pipeline would be 66 inches in diameter and 25.4 miles long.

Estimated costs

The capital costs are estimated at $62,390,000, including $55,700,000 for construction and $6,690,000 for interest during construction. The annual equivalent of these costs is estimated at $4,147,000. The annual

operating costs are estimated at $1,613,000, including $1,482,000 for purchase of power and $131,000 for operation, maintenance, and replacements. The sum of the estimated annual equivalent cost and the annual operating costs is $5,760,000 or $101 an acre-foot. The power costs are based on the purchase of 119,000,000-kilowatt-hours of energy and a maximum demand capacity of 16,000 kilowatts.

Water rights

It was assumed that the lessees would negotiate with the Yellow Jacket Water Conservancy District and obtain an agreement to use conditional decrees held by the district. These decrees have an early priority and are equal to or senior to most of the large conditional decrees on the White River in Colorado. No estimates have been made of the costs of acquiring the decrees.

Water quality

The water diverted would be of good quality for industrial use, with the total dissolved solids averaging 320 mg/l and ranging from 200 to 500 mg/l.

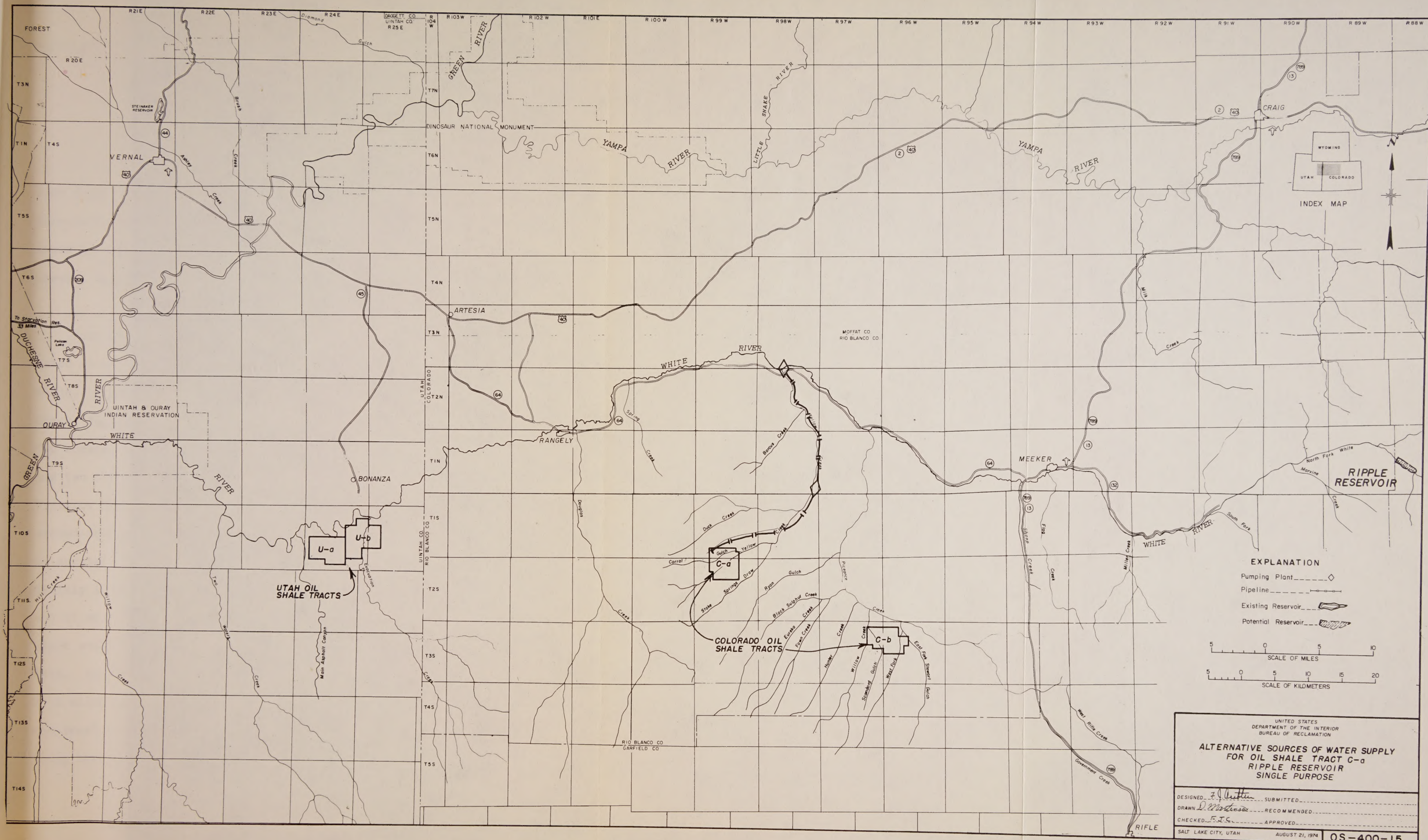
The Colorado River would be depleted by 57,000 acre-feet annually. This depletion would increase the salinity concentration of the river at Imperial Dam by 3.5 mg/l.

Environmental effects

The impacts of the pipeline and pumping plant features would be minimal. The pipelines would be located along existing transportation routes and intermittent stream channels. The pipelines would disturb a very narrow strip of land which would be reseeded and restored to its

natural condition after construction. Additional minor impacts would result from the construction and operation of pumping plants and associated power transmission lines.

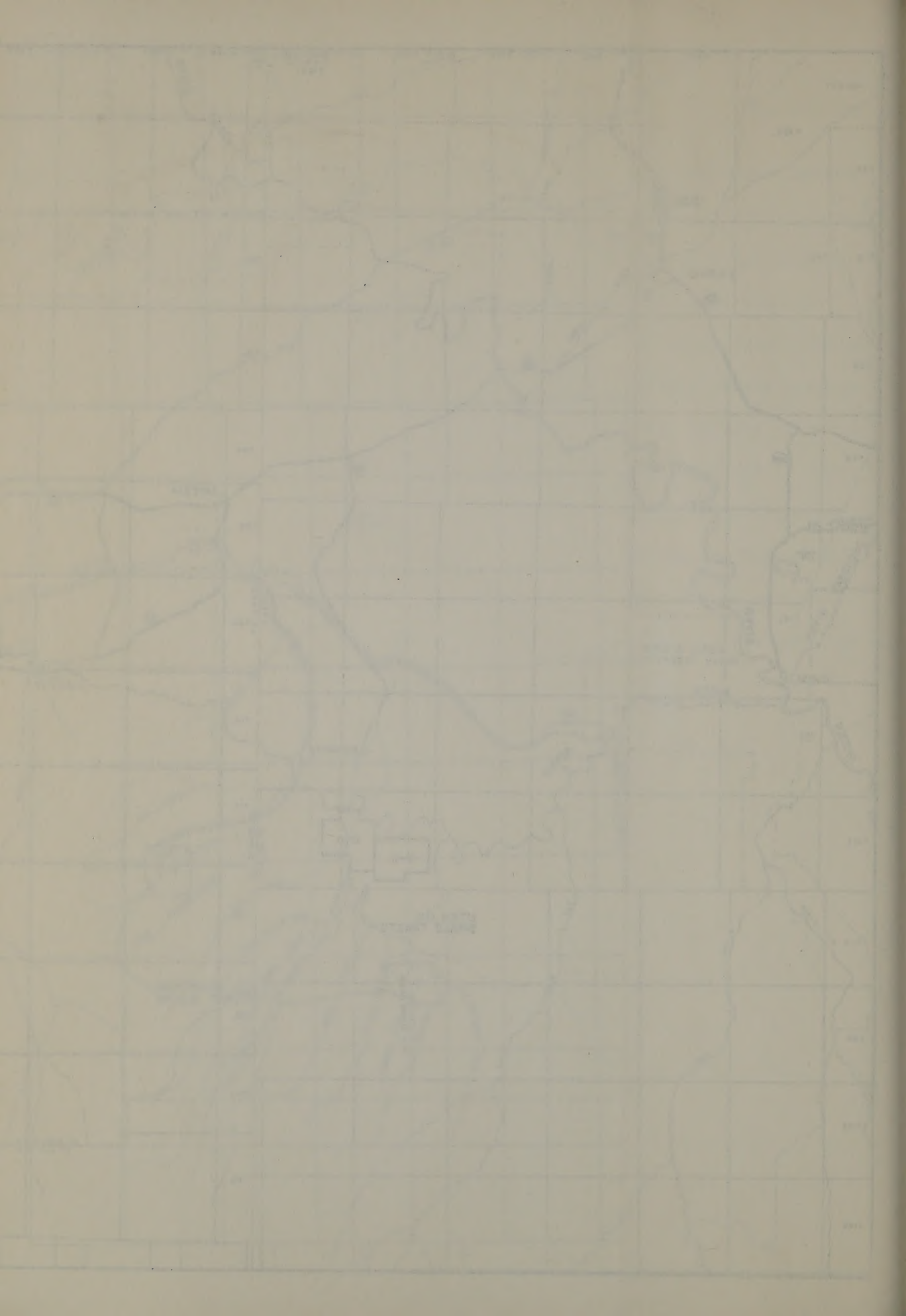
Ripple Reservoir would provide a new reservoir trout fishery and recreational opportunities in a high mountain setting. The reservoir would inundate 2 miles of high quality trout stream fishery and 350 acres of grazing land for big game and domestic livestock. Use of the basin is now restricted by private ownership but it would be open to the public with the development of the project. Below the reservoir, flows would exceed the historic average monthly flows in every month except the normal high runoff months of May and June, and fishing would be improved.



UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

ALTERNATIVE SOURCES OF WATER SUPPLY FOR OIL SHALE TRACT C-a RIPPLE RESERVOIR SINGLE PURPOSE

DESIGNED T.J. Mutter — SUBMITTED
DRAWN D. Mortensen — RECOMMENDED
CHECKED F.I.C. — APPROVED
SALT LAKE CITY, UTAH — AUGUST 21, 1974 — OS-400-15



Pumping from Colorado River for Tract C-b

Development plan

It has been assumed that the lessees of Tract C-b would obtain direct flows from the Colorado River to meet their requirements for 18,000 acre-feet and all that would be required to make the water available would be a pumping system and pipeline from the Colorado River to Piceance Creek. Features of the plan are shown on the map on page 47.

Project features

Four pumping plants would be constructed. The first would be located on the Colorado River approximately 4 miles east of the town of Rifle. A pump discharge pipeline would extend north and west to Piceance Creek, following along Government Creek and Colorado State Highway 13. Two booster pumping stations would be located approximately one third and two thirds of the distance between the first pumping station and Piceance Creek. Each of the three plants would have a capacity of 26 second-feet and a dynamic head of 773 feet. A fourth pumping plant would be located on Piceance Creek at the mouth of a small side drainage, approximately 12 miles downstream from the terminus of the pump discharge line, and it would make the final lift to the oil shale tract. This pumping plant would have a capacity of 26 second-feet and a dynamic head of 231 feet. Approximately 27.2 miles of pipeline would be required, including 24.1 miles from the Colorado River to Piceance Creek and 3.1 miles from the creek to the tract. The pipeline would be 36 inches in diameter and would have a capacity of 26 second-feet.

Estimated costs

The capital costs are estimated at $22,290,000, including $19,900,000 for construction and $2,390,000 for interest during construction. The annual equivalent of these costs is estimated at $1,482,000. The annual operating costs are estimated at $964,000, including $783,000 for purchase of power and $181,000 for operation, maintenance, and replacements. The sum of the estimated annual equivalent cost and the annual operating costs is $2,446,000 or $136 an acre-foot. The power costs are based on the purchase of 63,000,000-kilowatt-hours of energy and a maximum demand capacity of 8,600 kilowatts.

Water rights

It has been assumed that all of the 18,000 acre-feet required to supply Tract C-b could be obtained from the Colorado River through decrees presently held by the oil companies or by the purchase of existing decrees devoted to some other purpose, probably agriculture.

Water quality

The water diverted would be of good quality for industrial use. The total dissolved solids would average 500 mg/l. and would range from 160 to 930 mg/l.

The stream depletion of the Colorado River would be equal to the diversion or 18,000 acre-feet annually. This depletion would increase the salinity of the Colorado River at Imperial Dam by 0.7 mg/l.

Environmental effects

Only minimal environmental impacts would be expected from construction of the pipeline and pumping plant system. Most of the pipeline

would follow the right-of-way of a present highway and transmission line. All sections of pipe would be buried, and the land would be reseeded and restored as nearly as possible to its natural state. The short pipeline from Piceance Creek to Tract C-b would be located along a possible access route to the tract.

Ripple Reservoir for Tract C-b

Development plan

Approximately 18,000 acre-feet of water could be made available for Tract C-b by storage at Ripple Reservoir on the North Fork of the White River and diversion of direct flows of the river. Locations of potential features are shown on the map on page 42.

Project features

Ripple Reservoir on the North Fork would be constructed to a capacity of 9,000 acre-feet (8,000 acre-feet active). Water would be diverted from the river below Meeker at the mouth of Sheep Creek and conveyed along State Highway 13 to Piceance Creek. The conveyance system would consist of two pumping plants, each operating at a dynamic head of 615 feet, and a pipeline 17 miles long. The water would be released into Piceance Creek, rediverted about 12 miles downstream, and pumped to Tract C-b. This final lift would require a third pumping plant operating against a dynamic head of 231 feet and 3.2 miles of pipeline. The capacity of all the pipeline sections and the three pumping plants would be 26 second-feet. The pipeline would be 36 inches in diameter.

Estimated costs

The capital costs are estimated at $21,730,000, including $19,400,000 for construction and $2,330,000 for interest during construction. The annual equivalent of these costs is estimated at $1,444,000. The annual operating costs are estimated at $582,000. These annual costs include $448,000 for purchase of power and $134,000 for operation, maintenance,

and replacements. The sum of the estimated annual equivalent cost and the annual operating costs is $2,026,000 or $113 an acre-foot. The power costs are based on the purchase of 36,000,000-kilowatt-hours of energy and a maximum demand capacity of 5,000 kilowatts.

Water rights

The situation with respect to water rights and water quality for Ripple Reservoir for Tract C-b is the same as that for the reservoir for Tract C-a previously described.

The stream depletion of the Colorado River for service of Tract C-b would average 18,000 acre-feet annually or the amount of the diversion. The depletion would increase the salinity concentration of the Colorado River at Imperial Dam by 1.1 mg/l.

Environmental effects

The impacts of the pipeline and pumping plant features would be minimal. The pipelines would be located along existing transportation routes and intermittent stream channels. The pipelines would disturb only a narrow strip of land which would be reseeded and restored to its natural condition after construction. Additional minor effects would result from construction and operation of pumping plants and associated power transmission lines.

Ripple Reservoir would provide a new reservoir trout fishery and recreational opportunities in a high mountain setting. The reservoir would inundate less than 2 miles of high quality trout stream fishery and 230 acres of grazing land for big game and domestic livestock. Use of the basin is now restricted by private ownership but the area would

be open to the public with the development of the project. Below the reservoir, flows would exceed the historic average monthly flows in every month except the normal high runoff months of May and June, and fishing would be improved.

Alternative use of Ripple Reservoir for Tract C-b

An alternative means exists for conveying water to Tract C-b from the White River and utlizing storage water from Ripple Reservoir. Storage capacity at Ripple Reservoir would be the same as in the plan already discussed (9,000 acre-feet total and 8,000 acre-feet active).

Water would be diverted to Tract C-b from the White River by means of a pipeline and pumping system closely paralleling Piceance Creek. Two pumps, each with a dynamic head of 536 feet, would be required. The pipeline would be 27.3 miles long and 36 inches in diameter. Capacity of the two pumping plants and pipeline would be 26 second-feet.

Estimated costs

The capital costs are estimated at $27,550,000, including $24,600,000 for construction and $2,950,000 for interest during construction. The annual equivalent of these costs is estimated at $1,831,000. The annual operating costs are estimated at $427,000, including $329,000 for purchase of power and $98,000 for operation, maintenance, and replacements. The sum of the estimated annual equivalent cost and the annual operating costs is $2,258,000 or $126 an acre-foot. The power costs are based on the purchase of 26,000,000-kilowatt-hours of energy and a maximum demand capacity of 3,900 kilowatts.

FOREST

VERNAL

DINOSAUR NATIONAL MONUMENT

ARTESIA

RANGELY

CRAIG

MEEKER

RIFLE

BONANZA

OURAY

UINTAH & OURAY INDIAN RESERVATION

DUCHESNE RIVER

WHITE RIVER

GREEN RIVER

YAMPA RIVER

LITTLE SNAKE RIVER

SNAKE RIVER

UTAH COLORADO

DAGGETT CO.
UINTAH CO.

MOFFAT CO.
RIO BLANCO CO.

UINTAH CO.
RIO BLANCO CO.

RIO BLANCO CO.
GARFIELD CO.

U-a

U-b

UTAH OIL SHALE TRACTS

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RIPPLE RESERVOIR

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UTAH

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Pumping Plant

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SCALE OF MILES

SCALE OF KILOMETERS

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

ALTERNATIVE SOURCES OF WATER SUPPLY
FOR OIL SHALE TRACT C-b
RIPPLE RESERVOIR
SINGLE PURPOSE

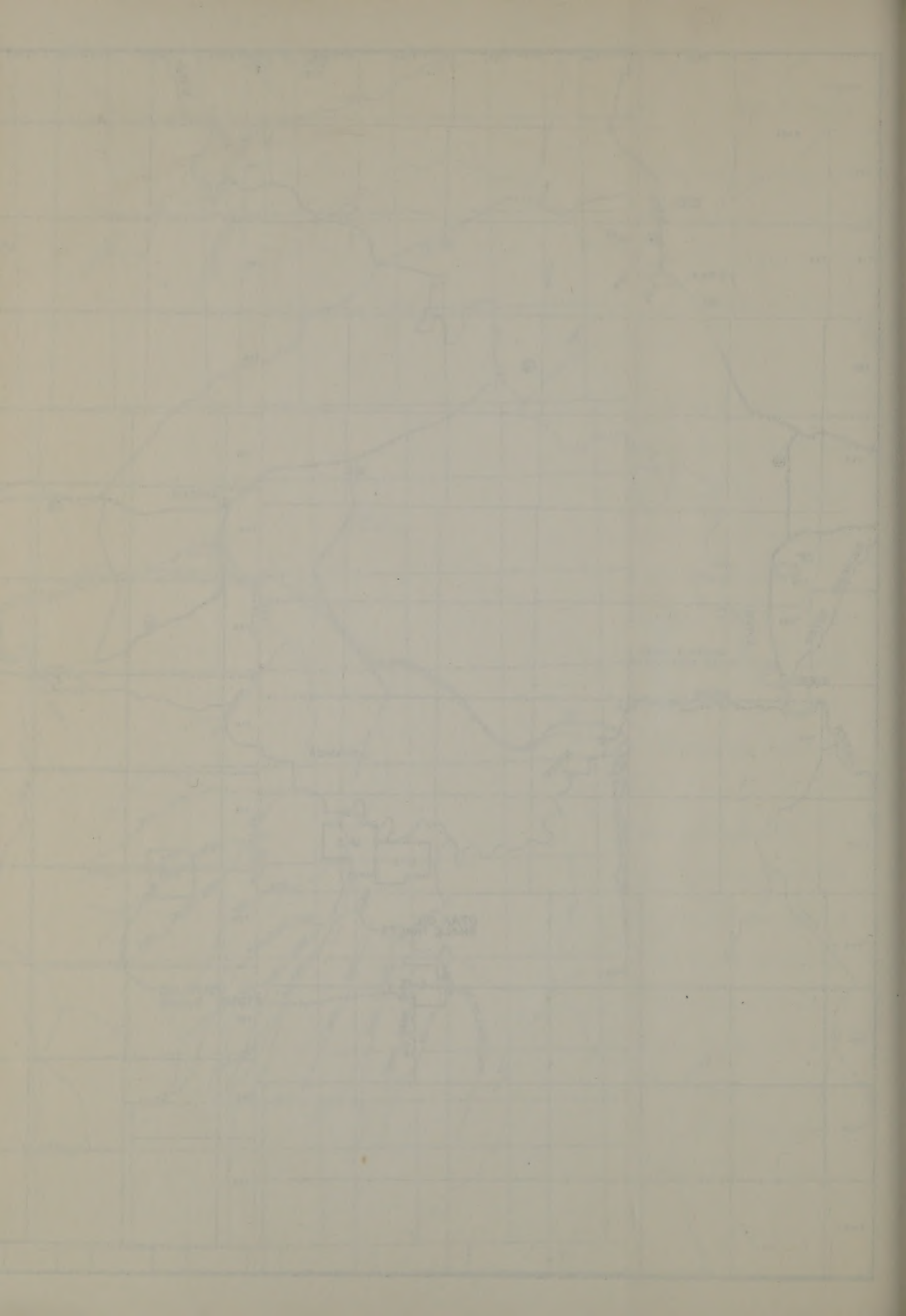
DESIGNED F.J. Cotter SUBMITTED

DRAWN D. Martinez RECOMMENDED

CHECKED E.J.C. APPROVED

SALT LAKE CITY, UTAH AUGUST 21, 1974

OS-400-14



Pumping From Colorado River For Tracts C-a and C-b

Development plan

The individual plans for pumping from the Colorado River to Tracts C-a and C-b, as discussed in the preceding sections, could be combined into a joint development. The source and supply of the water would be the same as previously discussed. Lessees of Tract C-a could purchase 57,000 acre-feet annually from Ruedi Reservoir and private owners. It is assumed that lessees of Tract C-b have sufficient water rights in the Colorado River to obtain the 18,000 acre-feet of water annually which they require. Potential features to serve both tracts are shown on the map on page 47.

Project features

Features required for the combined development to serve Tracts C-a and C-b would be similar to those of plans for the individual tracts previously discussed. A savings in construction costs could be effected by combining the water supply for both tracts and pumping it through a single pipeline from the Colorado River to Piceance Creek.

Three pumping plants and a 24-mile pipeline would convey the water from the Colorado River to Piceance Creek. The pipeline would be located generally along Colorado State Highway 13 to Piceance Creek. One pumping plant would be located on the Colorado River approximately 4 miles east of Rifle while the second and third plants would be located at approximately equal distances along the alinement. Each plant would have a capacity of 106 second-feet and would pump against a dynamic head

of 753 feet. The pipeline would be 66 inches in diameter and would have a capacity of 106 second-feet. The water from the pipeline would be released to and conveyed by the stream channel of Piceance Creek, to be rediverted and pumped near the oil shale tracts.

The 18,000 acre-feet for Tract C-b would be pumped from Piceance Creek at the mouth of Stewart Gulch. The water would be pumped by a plant with a capacity of 26 second-feet and a dynamic head of 231 feet. It would be conveyed in a concrete pipeline about 3 miles long with a diameter of 36 inches and a capacity of 26 second-feet. The 57,000 acre-feet of water for Tract C-a would be diverted from Piceance Creek at the mouth of Black Sulphur Creek. One pump would be located on Piceance Creek while a booster pump would be located approximately 5 miles to the west. Each plant would have a capacity of 80 second-feet and would pump against a head of 445 feet. Water would be conveyed to the tract in a concrete pipeline 16 miles long with a diameter of 66 inches and a capacity of 80 second-feet. The pipeline would cross two drainages between Piceance Creek and the tract.

Estimated costs

The capital costs for the combined development are estimated at $77,400,000, including $69,100,000 for construction and $8,300,000 for interest during construction. The annual operating costs are estimated at $4,620,000. The share of the costs for each tract is shown on the following page.

	Tracts	
	C-a	C-b
Capital costs		
Construction cost	$55,970,000	$13,130,000
Interest during construction	6,720,000	1,580,000
Total	62,690,000	14,710,000
Annual equivalent cost	4,167,000	978,000
Annual operating costs		
Water purchase	450,000	0
Power	2,949,000	857,500
Operation, maintenance, and replacements	273,500	89,500
Total	3,673,000	947,000
Total annual costs		
Total	7,840,000	1,925,000
Per acre-foot	138	107

Costs for water purchase are based on a rate of $15 an acre-foot but the actual rate would be subject to negotiation. The power costs are based on purchase of 306,561,000 kilowatt-hours of energy and a maximum demand capacity of 41,200 kilowatts.

Water rights

A portion of the water (30,000 acre-feet) could be obtained by contracting for water from Ruedi Reservoir. The balance (45,000 acre-feet) could be made available by acquisition of senior irrigation decrees on the Colorado River to provide a firm supply. No estimates have been made of the costs of acquiring the decrees.

Water quality

The water diverted would be of good quality for municipal and industrial use, with the concentration of dissolved solids ranging from 160 to 930 mg/l. and averaging about 500 mg/l. Flows of the Colorado River would be depleted by 75,000 acre-feet annually and the total dissolved solids of the river at Imperial Dam would be increased by 2.9 mg/l.

Environmental effects

The environmental impacts caused by construction would be minimal. The pipeline from the Colorado River to Piceance Creek would be located along the highway. The pipeline from Piceance Creek to Tract C-a would traverse an area that is sparsely covered with sagebrush and a semi-arid type ground cover. The area disturbed is about 95 acres in size and after construction it would be reseeded and restored as nearly as possible to its natural state. The pipeline from Piceance Creek to Tract C-b would be located along a possible access route to the tract.

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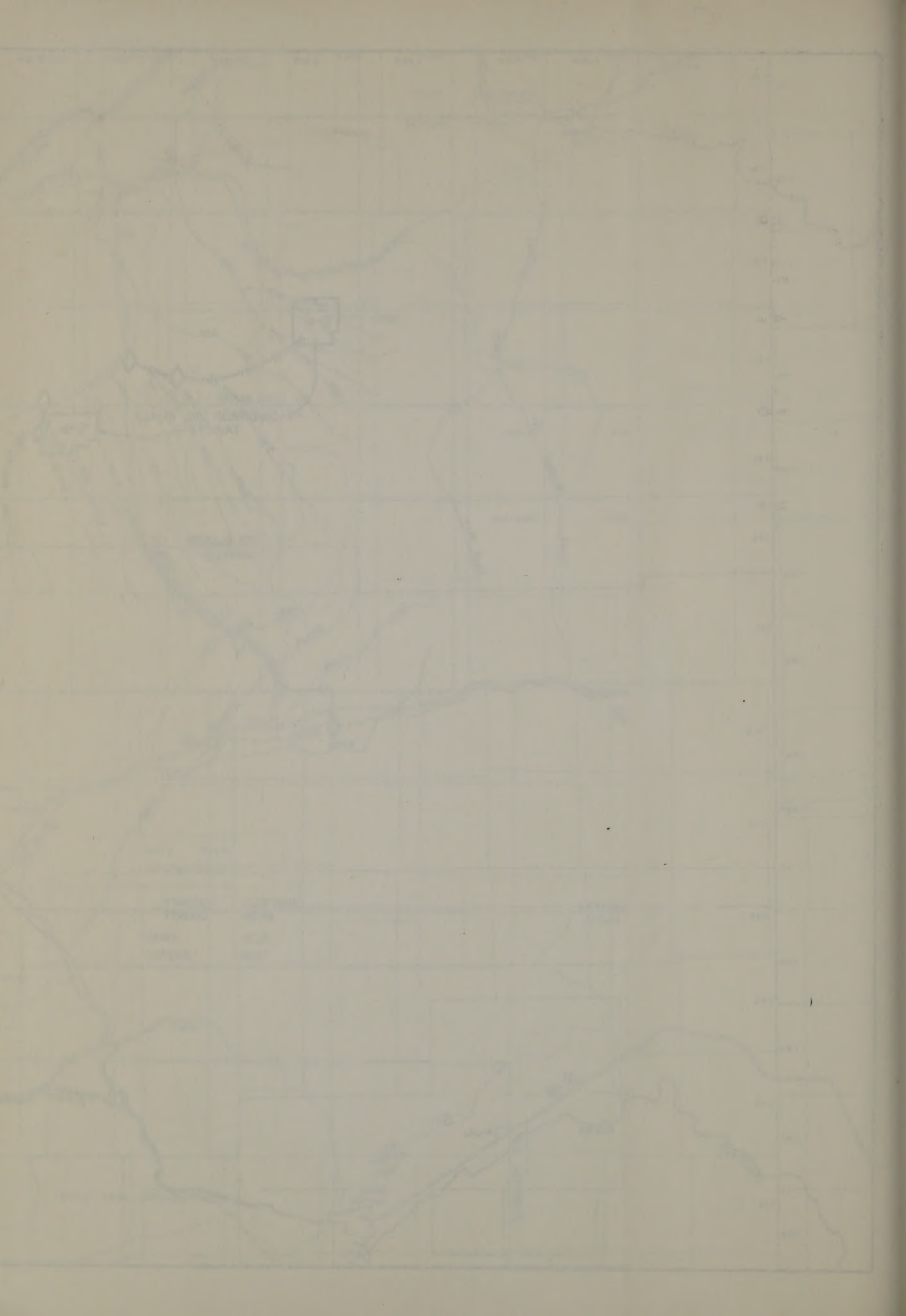
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

ALTERNATIVE SOURCES OF WATER SUPPLY FOR OIL SHALE TRACTS C-a AND C-b PUMPING FROM COLORADO RIVER SINGLE PURPOSE

DESIGNED F.J. Crabtree	SUBMITTED
DRAWN J.K. Mitchell	RECOMMENDED
CHECKED F.J.C.	APPROVED
SALT LAKE CITY, UTAH AUGUST 21, 1974	OS-400-3



Ground Water for Colorado and Utah Tracts C-a and C-b

It has been estimated that the annual recharge to ground water in the Piceance Creek Basin in Colorado is about 29,000 acre-feet a year.1/ This is discharged by evapotranspiration and subsurface flow into streams. It is possible that as much as 10,000 acre-feet of ground water a year for use on Tract C-a and 18,000 acre-feet a year for use on Tract C-b could be developed from mine dewatering and wells. Development of ground water could have an effect on streamflow and bottom land vegetation in the developed area. This could interfere with the rights of the present water users unless replacement water were obtained from another source or monetary consideration were given to the present users. It could also have an adverse effect on the environment by drying up wet and seep lands with the subsequent destruction of waterfowl and wildlife habitat.

Pumping of ground water in excess of the annual recharge (mining) is a feasible alternative whereby a critical water supply could be obtained for a specified period of time. No estimate has been made as to the amount of water that could be obtained from this source nor the costs involved.

Water quality considerations are significant in utilization of water developed by mine dewatering and wells. Total dissolved solids in water from the alluvial aquifer along major streams range from 469 to 6,720 mg/l, with a mean of 1,750 mg/l. The concentration of total dissolved solids in water from the Uinta formation and the upper part of

1/ Report on Water for Energy in the Upper Colorado River Basin, July 1974, page 35.

Parachute Creek member of the Green River formation varies from 345 mg/l. to 2,180 mg/l., with a mean of 960 mg/l. The concentration of total dissolved solids in water from the lower part of the Parachute Creek member of the Green River formation varies from 491 mg/l. to 38,900 mg/l., with a mean of 9,400 mg/l.

Tracts U-a and U-b

The ground water supply in the vicinity of the Utah oil shale tracts is so small that it would not support a significant oil shale industry.

Tyzack Reservoir for Tracts U-a and U-b

Development plan

Tyzack Reservoir is a potential feature of the Jensen Unit, which is a part of the Central Utah Project, authorized as a participating project of the Colorado River Storage Project by the act of April 11, 1956 (70 Stat. 105). Advance planning studies of the Jensen Unit are essentially completed.

Tyzack Reservoir would be located on Big Brush Creek about 10 miles northeast of Vernal, Utah, and 48 air miles north of Tracts U-a and U-b. The reservoir is planned for a capacity of 26,000 acre-feet to provide 4,700 acre-feet of water annually for irrigation and 18,000 acre-feet annually for municipal and industrial purposes. It also includes provisions for fish and wildlife and recreation. Approximately 10,000 acre-feet of the municipal and industrial supply is committed for use in the vicinity of Vernal but the remaining 8,000 acre-feet could be available for the new community of Bonanza in Utah planned to support oil shale development. The water would be purchased from local sponsors of the Jensen Unit.

Two methods of supplying water from the Tyzack Reservoir to the vicinity of Bonanza were investigated. Under one plan a pipeline would run the full distance from Tyzack Reservoir to Bonanza. Under the other plan water would be released from the reservoir into Big Brush Creek, a Green River tributary, then pumped from the Green River to Bonanza. The first plan requires more pipe, whereas the second requires more pumping

energy. The first plan would provide higher quality municipal water. There would be no problems of sediment deposition with either of the plans. Some riprap and flood protective measures would be required for the pumping plant in the Green River under the second plan. Features of the first plan are shown in the map on page 56.

Project features (Plan 1)

The first plan includes a pipeline 47.4 miles in length that would transport water from Tyzack Reservoir to the point of anticipated use near Bonanza. The pipeline would carry a 12-second-foot continuous flow. There would be 32.6 miles of 21-inch and 14.8 miles of 24-inch-diameter pipe. Two pumping plants would be needed with a total dynamic head of 660 feet. The pipeline would cross the Green River by suspended cables supported by a tower on each side of the river. A 4,000-acre-foot equalizing reservoir would be installed at the end of the pipeline near Bonanza to regulate the constant flow to an annual municipal demand pattern. Energy to operate the pumping plants could be obtained from an existing 69-kilovolt line that parallels the pipeline and is within less than a quarter mile of the pumping plants.

Estimated costs (Plan 1)

The capital costs are estimated at $16,190,000, including $14,450,000 for construction and $1,740,000 for interest during construction. The annual equivalent of these costs is estimated $1,076,000. The annual operating costs are estimated at $794,500. These annual costs include $440,000 for purchase of water, $104,500 for purchase of power and $250,000 for operation, maintenance, and replacements. The sum of the

estimated annual equivalent cost and the annual operating cost is $1,870,500 or $234 an acre-foot. Costs for water purchase are based on $55 an acre-foot but the actual cost would be subject to negotiation. The power costs are based on the purchase of 8,540,000 kilowatt-hours of energy and a maximum demand capacity of 1,000 kilowatts.

Project features (Plan 2)

The second plan mentioned for using Tyzack Reservoir water includes a release of 12 second-feet from the reservoir into Big Brush Creek and pumping of the water from the Green River. This development would require 14.8 miles of 24-inch and 10.4 miles of 21-inch diameter pipe. Two pumping plants would be needed with a total operating head of 1,035 feet. As in the first plan, a 4,000-acre-foot equalizing reservoir near Bonanza would also be needed. The same power source for Plan 1 was assumed to be available for Plan 2.

Estimated costs (Plan 2)

The capital costs are estimated at $10,283,000, including $9,181,000 for construction and $1,102,000 for interest during construction. The annual equivalent cost for these is estimated at $684,000. The annual operating costs are estimated at $746,400. These annual costs include $440,000 for purchase of water, $164,600 for purchase of power, and $141,800 for operation, maintenance, and replacements. The sum of the annual equivalent cost and the annual operating cost is $1,430,400 or $179 an acre-foot. Costs for water purchase are based on $55 an acre-foot but the actual cost would be subject to negotiation. The power costs are based on the purchase of 13,450,000 kilowatt-hours of energy and a maximum demand capacity of 1,600 kilowatts.

Water rights

The water supply in Tyzack Reservoir would be derived from storage of spring runoff of Big Brush Creek. The water rights for the Jensen Project were filed on by the Bureau of Reclamation and have Utah State Application No. 17558, dated April 23, 1946, and Application No. 30414-a, dated August 7, 1958. These filings include 18,000 acre-feet for municipal and industrial water.

Water quality

The water from Tyzack Reservoir would have an average content of dissolved solids of 150 mg/l and almost no suspended solids. Water of this quality could be provided to Bonanza under the first plan. Under the second plan the quality would not be as good because releases from Tyzack Reservoir would be mingled with lower quality water in the Green River.

Salinity in the Colorado River measured at the Imperial Dam is expected to be increased by 0.3 mg/l as a result of the use of 8,000 acre-feet of water from Tyzack Reservoir for municipal uses.

Environmental effects

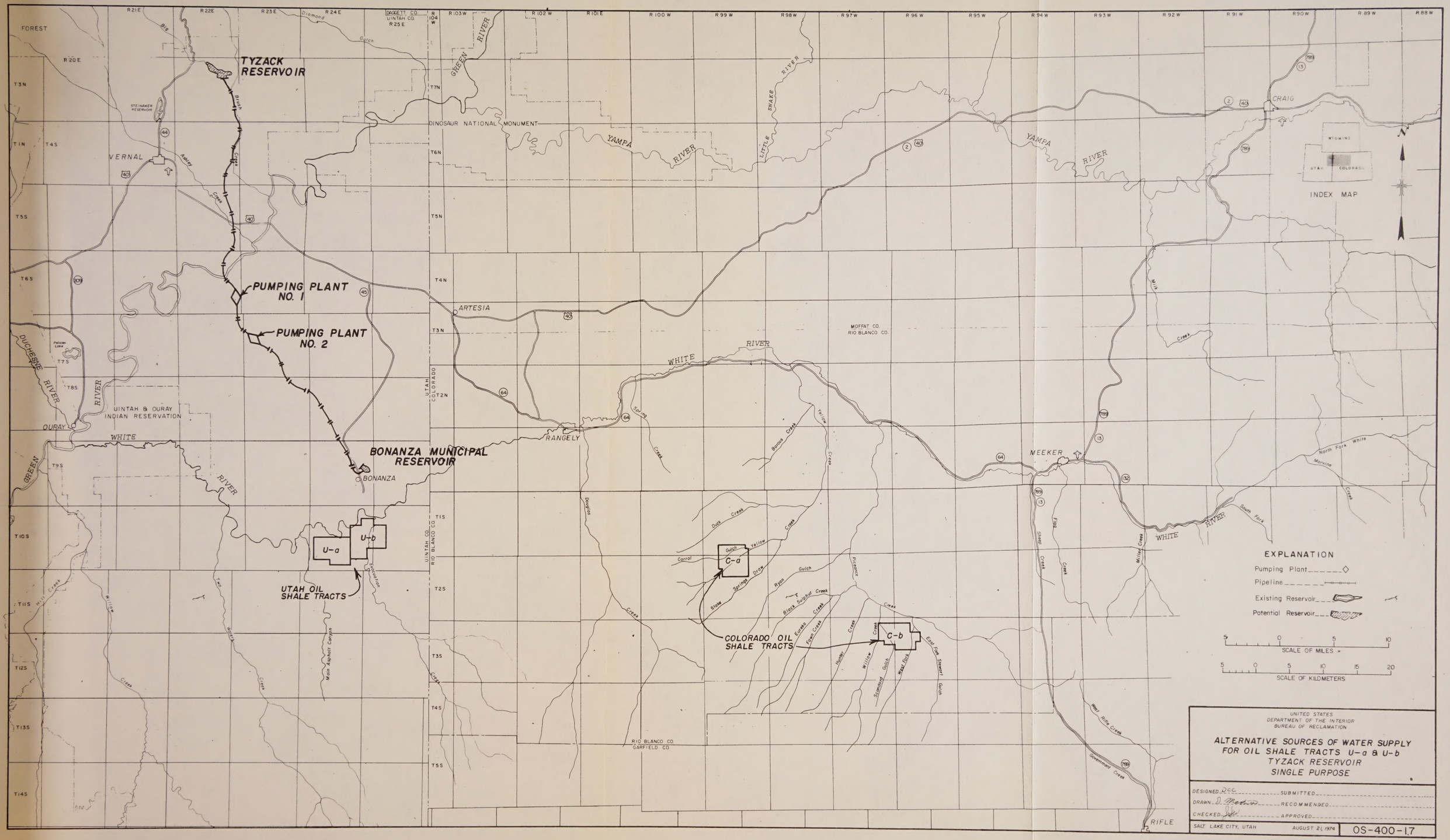
There would be insignificant changes to the fish and wildlife development plan for the Jensen Unit if the first plan were adopted; that is, if water were piped the full distance to Bonanza from Tyzack Reservoir. The water is part of scheduled municipal and industrial supplies and its use for oil shale would not interfere with fish and wildlife proposals in the Jensen Unit.

The 47.4 mile-long pipeline of the first plan would closely follow

an existing road for its full distance. About 4 miles would not follow a road and this area would be restored and reseeded after placement of the pipe. The upper part of the pipeline north of the Green River would traverse high desert lands covered with sagebrush and sparse juniper. The area south of the Green River is desert land with a sparse covering of shrubs and grasses. The oil industry has built numerous dirt roads in this area for servicing wells, pipelines, and tank collecting points. Some grading and surfacing would be required on the road paralleling the pipeline south of the Green River to make it a year-round road to service the pumping plants.

Each pumping plant would require less than 15 acres of land. A 60-foot right-of-way would be used during construction of the pipeline, and it would be restored and reseeded. Only short distances of service drop powerlines would be needed for the two pumping plants from existing powerlines.

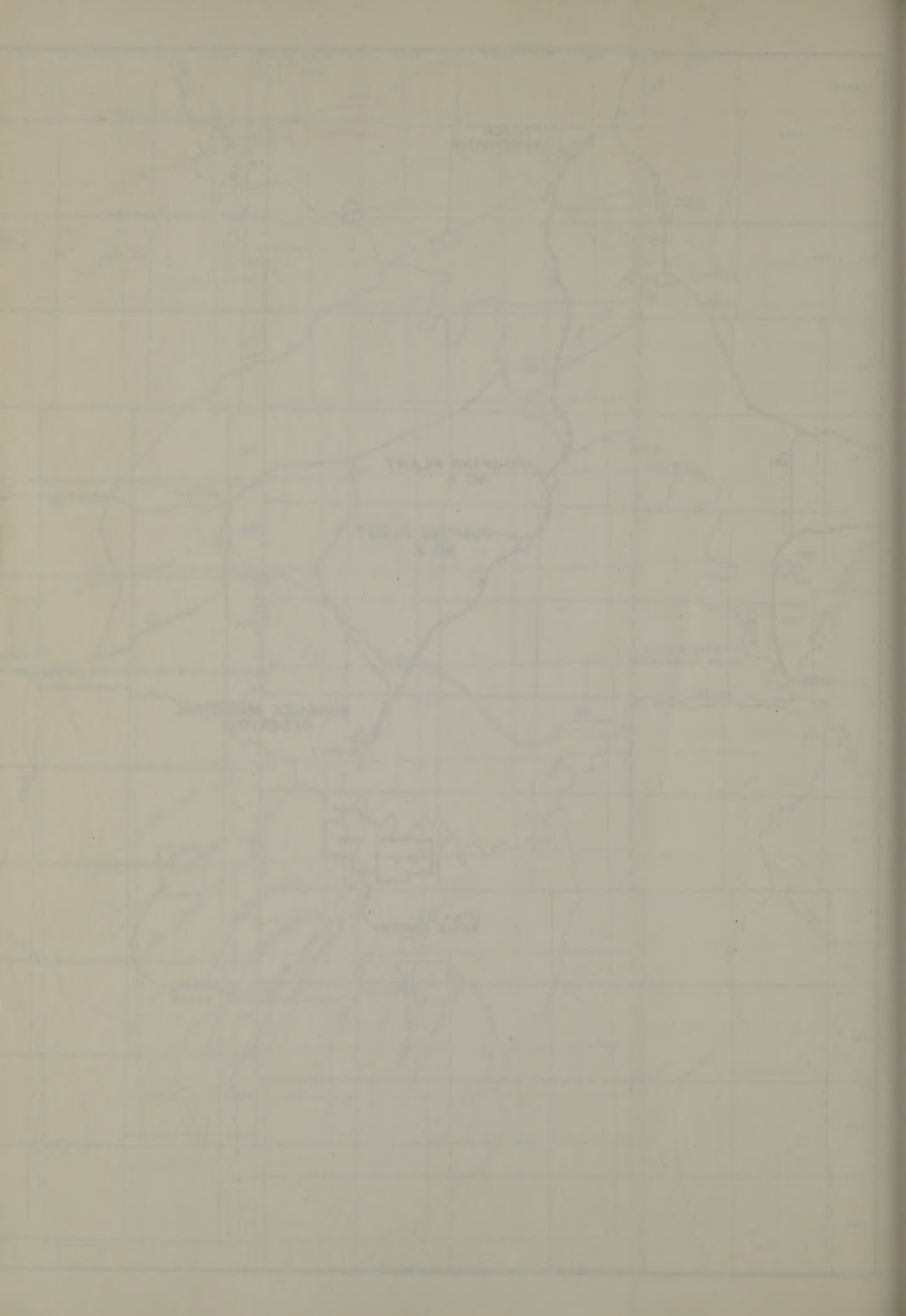
The second plan would eliminate the need for 22.2 miles of pipeline north of the Green River. It would improve the fishery on 60 river miles of Brush Creek by providing a continuous 12-second-foot streamflow. Fishery in the Green River would not be changed. The pipeline south of the Green River would follow the same alinement as in the first plan. There would be the same environmental considerations as above for restoring and reseeding. The powerlines would also be near the location mentioned in the first plan.



UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

ALTERNATIVE SOURCES OF WATER SUPPLY FOR OIL SHALE TRACTS U-a & U-b
TYZACK RESERVOIR
SINGLE PURPOSE

DESIGNED DCC	SUBMITTED
DRAWN D. Martin	RECOMMENDED
CHECKED JW	APPROVED
SALT LAKE CITY, UTAH — AUGUST 21, 1974	OS-400-1.7



Watson Reservoir for Tracts U-a and U-b

Development plan

A single-purpose reservoir could be constructed on the White River to furnish 36,000 acre-feet of municipal and industrial water for the oil shale lease tracts in Utah. Watson Dam site in sec. 8, T. 1 S., R. 25 E., Salt Lake Meridian, was selected for this plan. This site is about 2½ miles upstream from the old Ignatio Stage stop and about even with the easternmost boundary of oil shale Tract U-b. This location would make it possible to provide industrial flows downstream to the lease tracts at the old Ignatio Stage stop. Municipal water would be pumped for use in the vicinity of Bonanza. Features of the plan are shown on the map on page 61.

Project features

The facilities required to provide 36,000 acre-feet of water for municipal and industrial uses in this plan are Watson Dam and Reservoir and a pumping plant to pump municipal water to Bonanza.

Watson Reservoir would have a capacity of 102,000 acre-feet, including 27,000 of active capacity and 75,000 of inactive and dead capacity for sediment retention over a 50-year period. Provision of reservoir storage space for sediment retention is one of the major problems associated with the construction of storage facilities on the Lower White River. Watson Dam would be an earth-fill structure about 140 feet high. The outlet works would have a capacity of 1,500 second-feet and the spillway a capacity of 50,000 second-feet.

CHAPTER III

Watson Reservoir
for Trestle Lee and Ivy

Introductory Plan

A single-purpose reservoir could be constructed on the Turtle River to furnish 9,000 acre-feet of municipal and industrial water for the oil-shale leases therein to Utah. Watson Dam site is to sec. 7, T. 1 S., R. 25 E., Salt Lake Meridian, was selected for this plan. This site is about 65 miles upstream from the old Trestle Ferry and about even with the northernmost boundary of oil shale tract U-a. This location would make it possible to provide industrial flows downstream to the Lower Trestle at the old Trestle Ferry site. Municipal water would be piped for use in the vicinity of Bonanza. Features of the plan are shown on the plan on page 61.

Project Features

The facilities required to provide 9,000 acre-feet of water for municipal and industrial uses in this plan are Watson Dam and Reservoir and a pumping plant to pump municipal water to Bonanza.

Watson Reservoir would have a capacity of 103,000 acre-feet, including 83,000 of active capacity and 19,000 of inactive and dead capacity for sediment retention over a 50-year period. Provision of reservoir storage space for sediment retention is one of the major problems associated with the construction of storage facilities on the Lower White River. Watson Dam would be an earth-fill structure about 190 feet high. The outlet works would have a capacity of 1,300 second-feet and the spillway a capacity of 50,000 second-feet.

Water for industrial purposes would be released to the stream channel for downstream diversion. A pumping plant would be required at the outlet works of the dam to pump the municipal water over a ridge just south of Bonanza. Water would be conveyed in a pipeline 3.2 miles long and with a diameter of 36 inches. The capacity of the pump and pipeline would be 40 second-feet to meet the peak summer demands. The pumping plant would have a dynamic head of about 510 feet. Pumping power could be obtained from a 69-kilovolt line located at Bonanza.

Estimated costs

The capital costs of the development are estimated at $24,590,000, including $21,950,000 for construction and $2,640,000 for interest during construction. The annual equivalent of these costs is estimated at $1,635,000. The annual operating costs are estimated at $247,100, including $183,200 for purchase of power and $63,900 for operation, maintenance, and replacements. The sum of the estimated annual equivalent cost and the annual operating cost is $1,882,100 or $53 an acre-foot. The power costs are based on the purchase of 15,100,000 kilowatt-hours of energy and a maximum demand capacity of 2,800 kilowatts.

Water supply

The water supply would be obtained from the unused flows of White River. To determine the water available, historical flows were modified to reflect future upstream development for municipal, industrial, and irrigation uses for the Bureau of Reclamation's Yellow Jacket Project. In addition to these uses, water was bypassed for irrigation of land on the Uintah and Ouray Indian Reservation and for stream fishery flows.

The Indian irrigation water would be for Group 6 and 7 lands near Ouray, Utah. These lands have water right Application Nos. 577, 712, and 4356 as well as water rights claimed under the Winters' Doctrine. The Fish and Wildlife Service recommended streamflows of 210 second-feet during the winter period and 420 second-feet during the summer period from Watson Dam to the Green River, a distance of about 30 miles. The irrigation and fishery requirements were met so far as possible from direct streamflows only, with no release from storage.

Water quality

Total dissolved solids of the White River at the Watson Dam site range from 250 to 800 mg/l., with an average of about 550 mg/l. Since the water would be stored in a reservoir, it is expected that through mixing it would remain at about the average quality level.

Delivery of 36,000 acre-feet to the oil shale tracts for municipal and industrial uses would result in an estimated 24,000-acre-foot depletion of the river system annually. Total dissolved solids of the Colorado River at Imperial Dam would be increased by about 1.4 mg/l.

Water rights

The water right on the White River that could be used by the developers for this plan would be water right Application No. 36979, dated May 19, 1965, and filed by the Utah Division of Water Resources.

Environmental effects

The White River has been included in a study for proposed wild and scenic river status. The development of a storage reservoir would alter

the status in this reach of the river. In the 30 miles of river below the reservoir to Green River the flow would be maintained at 420 second-feet during April to September and 210 second-feet from October to March or the river flow whichever is less. These flows would maintain the fishery in the river. With the reservoir in place the sediment content in this section of the White River would be reduced by about 95 percent.

The reservoir would inundate about 2,300 acres of area along the river. About 10 miles of river would also be inundated. Because of the steepness of the shoreline only a small amount of mud flat would be exposed. This would be mainly at the upstream end of the reservoir. Also because of the steepness of the shoreline, access to the reservoir for recreational purposes and shore fishing would be limited to the flatter areas.

The reservoir would have a large dead and inactive storage capacity which would be used for fishery and recreation for many years. The reservoir would have an annual maximum fluctuation in water surface of about 10 feet.

Consideration was given to several alternative dam and reservoir sites up and down the White River from the selected Watson site. Off-stream sites were also considered. From an economic standpoint and also with respect to proximity to the shale tracts, the Watson site appears to be the most desirable. Additional studies would be required to confirm the selection of the site.

VERNAL
CRAIG
ARTESIA
RANGELY
MEEKER
RIFLE
OURAY
BONANZA
DINOSAUR NATIONAL MONUMENT
UINTAH & OURAY INDIAN RESERVATION
GREEN RIVER
YAMPA RIVER
WHITE RIVER
DUCHESNE RIVER
LITTLE SNAKE RIVER
BONANZA MUNICIPAL PIPELINE & PUMP
WATSON RESERVOIR
U-a
U-b
UTAH OIL SHALE TRACTS
C-a
C-b
COLORADO OIL SHALE TRACTS
MOFFAT CO.
RIO BLANCO CO.
RIO BLANCO CO.
GARFIELD CO.
UTAH
COLORADO
INDEX MAP
WYOMING
EXPLANATION
Pumping Plant
Pipeline
Exisfina Reservoir
Potential Reservoir
SCALE OF MILES
SCALE OF KILOMETERS
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
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FOR OIL SHALE TRACTS U-a & U-b
WATSON RESERVOIR
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SALT LAKE CITY, UTAH
AUGUST 21, 1974
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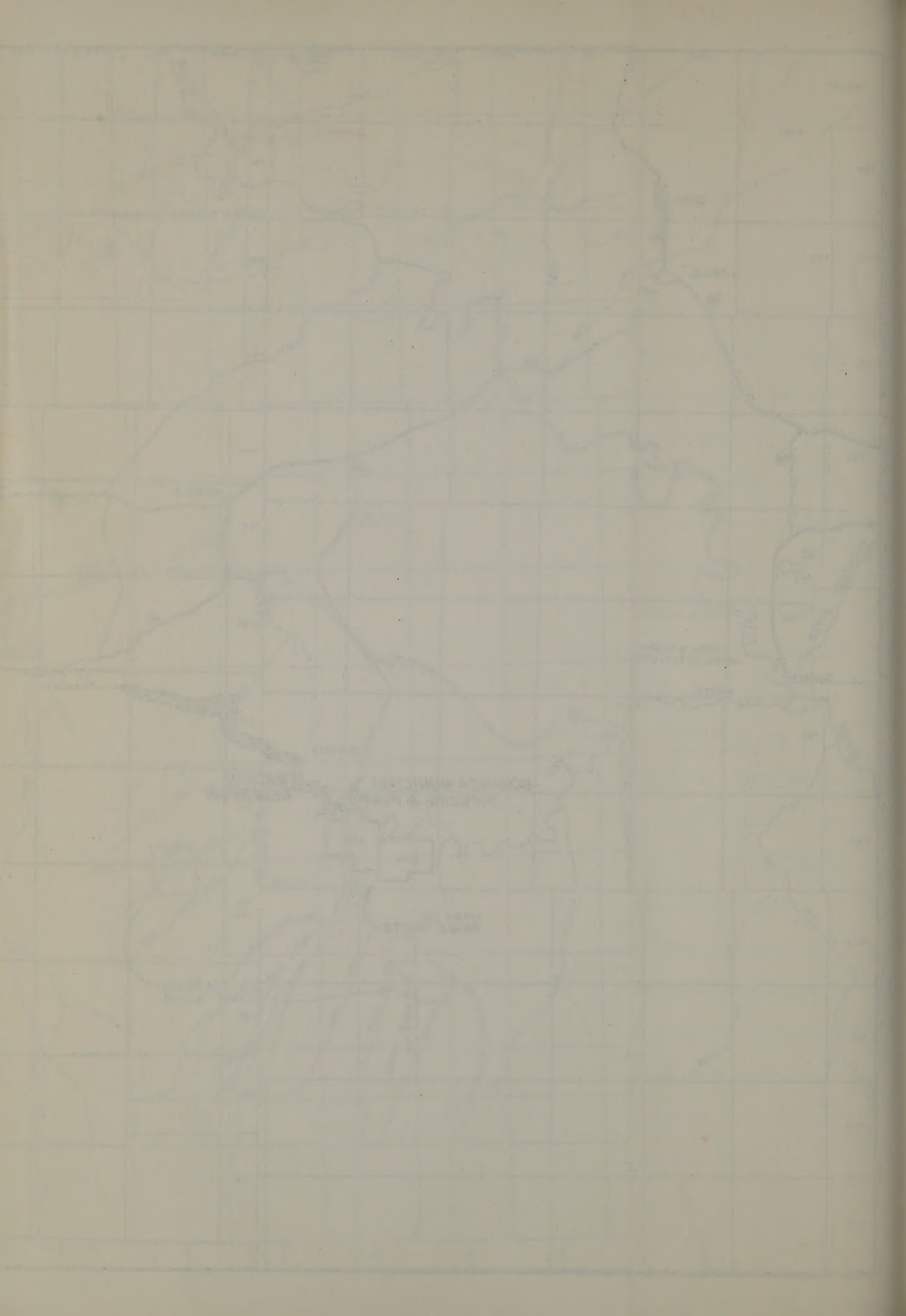

Hells Hole Canyon Reservoir for Tracts U-a and U-b

Development plan

One possiblity for single-purpose development on the White River is an offstream reservoir in Hells Hole Canyon. A reservoir could be located near the canyon's intersection with the White River approximately 4 miles southeast of the town of Bonanza, and approximately 1 mile upstream from the easternmost edge of the oil shale tracts. The water for development would be the unused flows of the White River which would be pumped into Hells Hole Canyon Reservoir for regulation. Thirty-six thousand acre-feet of municipal and industrial water would be developed. Features of the plan are shown on the map on page 66.

Project features

A 325-second-foot pumping plant with a dynamic head of 270 feet would be provided for diversion of water from the White River to Hells Hole Canyon Reservoir. The water would be conveyed in a pipeline a half mile long with a diameter of 78 inches and a capacity of 325 second-feet. A diversion structure and intake channel would be provided on the river. Also as sediment content of the river is high at the diversion point, a settling pond and a sluiceway for return of sediment to the river would be provided.

Hells Hole Canyon Reservoir would have a total capacity of 25,000 acre-feet, with a 300-second-foot outlet and a 1,000 second-foot spillway. The dam structure would be 294 feet high. No dead or inactive storage would be provided. Reservoir capacity for sediment accumulation would be unnecessary.

Releases for industrial use would be made from the reservoir to the river. A 40-second-foot pumping plant with a head of 405 feet would be required to lift the municipal supply from the reservoir to Bonanza. The pipeline from the reservoir to Bonanza would be 3.4 miles long. It would be 36 inches in diameter and would have a capacity of 40 second-feet.

Estimated costs

The capital costs of development are estimated at $30,700,000, including $27,410,000 for construction and $3,290,000 for interest during construction. The annual equivalent of these costs is estimated at $2,041,000. The annual operating costs are estimated at $459,500, including $348,900 for purchase of power and $110,600 for operation, maintenance, and replacements. The sum of the annual equivalent cost and the annual operating cost is $2,500,500 or $70 an acre-foot. The power costs are based on the purchase of 25,410,000 kilowatt-hours of energy and a maximum demand capacity of 12,800 kilowatts.

Water supply

In computing unused flows available for development from the White River, an adjustment was made to reflect future upstream development of municipal, industrial, and irrigation uses under the Yellow Jacket Project. In addition, it was assumed that Indian irrigation rights of 38,000 acre-feet annually under water right Application Nos. 577, 712 and 4356 must be met. Fishery flows of 210 second-feet in winter and 420 second-feet in summer, as recommended by the Fish and Wildlife Service, would also have first priority to "run of the stream" water. These uses would have no right to project stored water. Inflow from the Hells Canyon

drainage area were estimated to be negligible. Using this approach, it was found to be feasible to supply the 36,000 acre-foot municipal and industrial requirement of the oil shale industry. Water rights for this water would be the same as those discussed in the Watson Reservoir single-purpose plan.

Water quality

Total dissolved solids in the White River near the oil shale tracts range between 250 and 800 mg/l, with an average of approximately 560 mg/l. Since the water stored in Hells Hole Canyon Reservoir would be essentially from periods of high runoff and often correspondingly low salt content, it is estimated the salt content of the stored water would have an average content of dissolved solids of 500 mg/l. This value is at the U.S. Public Health Service's preferred limit of 500 mg/l for drinking water. The salinity may be expected to remain far below the Public Health Service's maximum allowable limit of 1,000 mg/l.

System depletion

Delivery of the 36,000 acre-feet for oil shale development would result in an estimated 24,000 acre-foot annual depletion of the river system. As a consequence, the salinity in the Colorado River at Imperial Dam may be expected to increase by 1.4 mg/l.

Flood design

Although it was found that the flows from the Hells Hole Canyon would make a negligible contribution to the water supply, it would be necessary to protect against possible flood from this source. The flood storage necessary was estimated to be 5,500 acre-feet. This flood flow

was accomodated in the plan by storage rather than spill although a small emergency spillway was included in the plan.

Environmental effects

The White River is under consideration as a wild and scenic river. Construction of this project would alter such consideration in the reach of the river where construction is planned. Care would be required in the design and construction phases of the pumping plant and intake facilities on the White River so that they would blend with the surrounding area. Flows of the river would be maintained near the recommended level for the stream fishery. Sediment in the river would remain at a high level.

The stream in Hells Hole Canyon has intermittent flows and does not presently have fishery potential. The reservoir would inundate about 260 acres at normal water surface elevation. The reservoir would fill and empty almost every year. Because of widely varying reservoir levels, it is unlikely that the reservoir would provide significant recreational use. Since filling of the reservoir would require pumping from the White River, no dead or inactive capacity would be provided. Lack of such storage would eliminate the reservoir as a fishery and would also severely reduce the recreation potential.

Consideration was given to several alternative offstream dam and reservoir sites both up and downstream from the selected site. Based on the information available, the Hells Hole Canyon Dam and Reservoir sites are considered the most desirable both because of economics and location with respect to the Utah lease tracts.

FOREST
R21E
R22E
R23E
R24E
DAGGETT CO
UINTAH CO
R25E
R104W
R103W
R102W
R101E
R100W
R99W
R98W
R97W
R96W
R95W
R94W
R93W
R92W
R91W
R90W
R89W
R88W
R20E
T3N
T7N
T1N
T4S
T6N
T5S
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T9S
T10S
T11S
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T13S
T14S
T1S
T2S
T3S
T4S
T5S
GREEN RIVER
DINOSAUR NATIONAL MONUMENT
YAMPA RIVER
LITTLE SNAKE RIVER
SNAKE RIVER
CRAIG
VERNAL
STEINAKER RESERVOIR
ASHLEY CREEK
BRUSH CREEK
DIAMOND
GUSHER
ARTESIA
DUCHESNE RIVER
PELICAN LAKE
UINTAH & OURAY INDIAN RESERVATION
OURAY
WHITE RIVER
RANGELY
MOFFAT CO
RIO BLANCO CO
MEEKER
MILK CREEK
NORTH FORK WHITE
MORAINE CREEK
SOUTH FORK
MILLER CREEK
BONANZA
MUNICIPAL PIPELINE
PUMPING PLANT
HELLS HOLE CANYON RESERVOIR
U-a
U-b
UTAH OIL SHALE TRACTS
C-a
C-b
COLORADO OIL SHALE TRACTS
RIO BLANCO CO
GARFIELD CO
RIFLE
WEST RIFLE CREEK
GOVERNMENT CREEK
DOUGLAS CREEK
YELLOW CREEK
BOROUS CREEK
CARR GULCH
SPRINGS DRAW
RYAN GULCH
BLACK SULPHUR CREEK
EUREKA CREEK
FIRE CREEK
PICEANCE CREEK
HUNTER CREEK
WILLOW CREEK
STANSBURY GULCH
MAIL GULCH
EAST FORK STEWART GULCH
HUBER CREEK
HILL CREEK
WILLOW CREEK
WATER CREEK
MAIN ASPHALT CANYON
EXPLORATION
SPRING CREEK

INDEX MAP
WYOMING
UTAH
COLORADO

EXPLANATION
Pumping Plant ◇
Pipeline
Existing Reservoir
Potential Reservoir

SCALE OF MILES
5 0 5 10
SCALE OF KILOMETERS
5 0 5 10 15 20

UNITED STATES
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DESIGNED — SUBMITTED
DRAWN — RECOMMENDED
CHECKED — APPROVED
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CHAPTER IV

MULTIPLE-PURPOSE DEVELOPMENTS

West Divide Project for Tracts C-a and C-b

Development plan

A West Divide Project could be constructed to develop 75,000 acre-feet of water for use on oil shale Tracts C-a and C-b. It was assumed for this study that storage for the municipal and industrial water would be provided at Una Reservoir on the Colorado River. The reservoir could also provide new opportunities for recreation and fishing. Water would be released from the reservoir to replace that which would be diverted at Rifle and pumped to the oil shale tracts. The West Divide Project could also provide water for fishing, recreation, flood control, and irrigation from facilities other than Una Reservoir. Features of the plan are shown on the map on page 70.

Project features

Una Reservoir would be constructed to provide regulatory storage. The pumping facilities for the project would be the same as those in the single-purpose development previously discussed for pumping from Colorado River to Tracts C-a and C-b.

Una Reservoir would be located on the Colorado River west of the town of Grand Valley at the Mesa-Garfield County line. The reservoir would have an active capacity of 61,000 acre-feet and a total capacity of 196,000 acre-feet. The dead storage is planned to take care of the large deposition of sediment in the river. The construction of the

reservoir would require the relocation of existing U.S. Highway 6 and 24 and the main line tracks of the Denver and Rio Grande Western Railroad. Costs of the relocations have been included in the estimates for the dam. Una Reservoir is being considered as a substitute for Placita Reservoir located on the Crystal River south of Glenwood Springs, which was included in the feasibility plan for the West Divide Project. Construction of a project based on the feasibility plan was authorized by the Colorado River Basin Act of September 30, 1968 (Public Law 90-527) as a participating project under the Colorado River Storage Project Act.

Estimated costs

The construction cost of Una Dam and Reservoir is estimated at $59,500,000. The capital cost of the dam and reservoir for development of water for oil shale and associated pumping facilities is estimated at $144,040,000, including $128,600,000 for construction and $15,440,000 for interest during construction. The annual operating costs of the water development for oil shale are estimated at $4,180,000. The share of the costs of developing water for each oil shale tract is shown.

	Tracts	
	C-a	C-b
Capital costs		
Construction cost	$97,740,000	$30,860,000
Interest during construction	11,730,000	3,710,000
Total	109,470,000	34,570,000
Annual equivalent cost	7,275,000	2,300,000
Annual operating costs		
Power	2,949,500	857,500
Operation, maintenance, and replacements	283,500	89,500
Total	3,233,000	947,000
Total annual costs		
Total	10,508,000	3,247,000
Per acre-foot	185	180

The power costs are based on purchase of 307,000,000-kilowatt-hours of energy and a maximum demand capacity of 41,200 kilowatts.

Water rights

Conditional decrees for the West Divide Project are held by the Colorado River Water Conservation District with an appropriation date of April 22, 1957. The district also holds a conditional decree for Una Reservoir with a date of March 16, 1965.

Water quality

The water diverted would be of good quality for municipal and industrial use, with the total dissolved solids ranging from 160 to 930 mg/l. and averaging 500 mg/l. Flows of the Colorado River would be depleted by 75,000 acre-feet annually and salinity concentrations of the river at Imperial Dam would be increased by about 2.9 mg/l.

Environmental effects

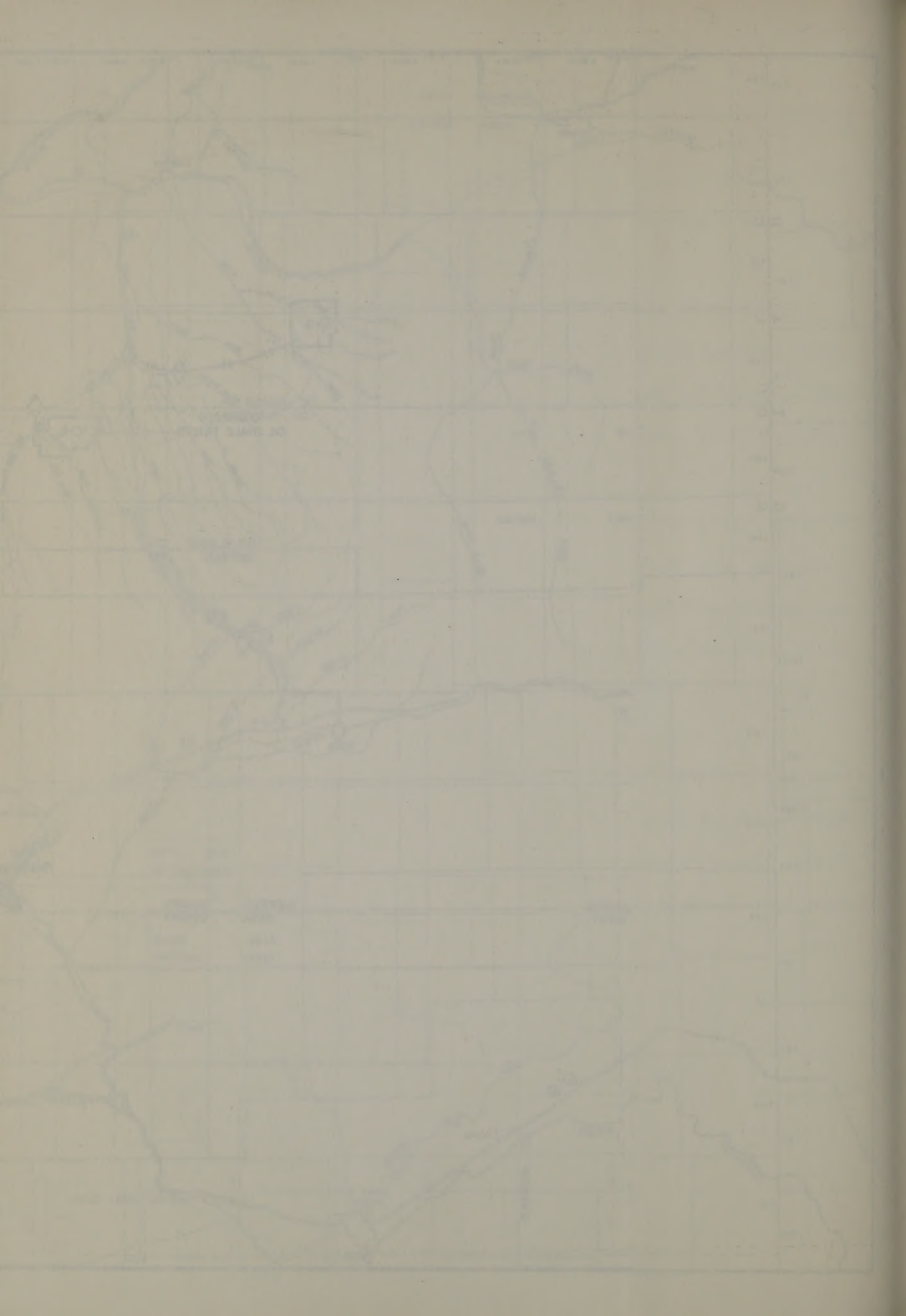
Una Reservoir would inundate about 9 miles of the Colorado River and 4,230 acres of land. This land is used for agriculture and wildlife habitat. The environmental impacts from the pumping system would be the same as previously discussed for plans for pumping water from the Colorado River.

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

ALTERNATIVE SOURCES OF WATER SUPPLY FOR OIL SHALE TRACTS C-a AND C-b WEST DIVIDE PROJECT MULIPLE PURPOSE

DESIGNED F.J. Coulter — SUBMITTED
DRAWN J.K. Mitchell — RECOMMENDED
CHECKED E.J.C. — APPROVED

SALT LAKE CITY, UTAH — AUGUST 21, 1974 — OS-400-2



Lower Yampa Project for Tracts C-a and C-b

Development plan

The Lower Yampa Project could provide 75,000 acre-feet of water for oil shale development, including 57,000 acre-feet for Tract C-a and 18,000 acre-feet for Tract C-b. Features of the plan are shown on the map on page 75.

Status of investigations

Feasibility investigations of a Lower Yampa Project were initiated in FY 1968 and discontinued in FY 1974 because of lack of funds.

Project features

Storage would be provided by Juniper Reservoir on the Yampa River 18 miles west of Craig. The reservoir would be built to a total capacity of 879,000 acre-feet and an active capacity of 181,200 acre-feet. The reservoir has been planned to yield 100,000 acre-feet of water for municipal and industrial use; however, only 75,000 acre-feet would be diverted to the White River Basin for oil shale development. Storage also would be provided in the reservoir for release to irrigation and power. The reservoir would also provide new opportunities for recreation and fishing.

A pumping plant with a capacity of 106 second-feet would be located near the high water line on the south side of the reservoir. This pump, along with two booster stations, would lift water from the reservoir over the divide between the Yampa and White River Drainages. The water then would flow through a long siphon across the White River east of Meeker and along Colorado State Highway 13 to Fourteen Mile Creek, a tributary of Piceance Creek.

Lower Verde Project for Trench C-a and C-b

Development plan

The Lower Verde Project could provide 75,000 acre-feet of water for oil shale development, including 57,000 acre-feet for Trench C-a and 18,000 acre-feet for Trench C-b. Features of the plan are shown on the map on page 72.

Status of Investigations

Feasibility investigations of a Lower Verde Project were initiated in FY 1968 and discontinued in FY 1974 because of lack of funds.

Project Features

Storage would be provided by Chapter Reservoir on the Verde River 30 miles west of Cleio. The reservoir would be built to a total capacity of 870,000 acre-feet and an active capacity of 675,000 acre-feet. The reservoir has been planned to yield 100,000 acre-feet of water for municipal and industrial uses; however, only 75,000 acre-feet would be diverted to the White River basin for oil shale development. Storage also would be provided in the reservoir for releases to irrigation and power. The reservoir would also provide new opportunities for recreation and fishing.

A pumping plant with a capacity of 100 second-feet would be located near the high water line on the south side of the reservoir. This pump, along with two booster stations, would lift water from the reservoir over the divide between the Verde and White River Drainages. The water then would flow through a long siphon across the White River west of Meeker and along Colorado State Highway 13 to Fortification Mile Creek, a tributary of Piceance Creek.

The main pumping plant and the two booster plants would be identical in size, each pumping against a head of 496 feet and each having a capacity of 106 second-feet. The first booster plant would be located about 7 miles south of the main plant while the second would be about 6 miles south of the first booster and about 6 miles below the high point. The pipeline from Juniper Reservoir to Fourteen Mile Creek would be about 51 miles long and would have a diameter of 66 inches and a capacity of 106 second-feet. At the end of this line the water would be released to the stream channel and rediverted at two downstream locations on Piceance Creek nearer the oil shale tracts.

The water for Tract C-b would be diverted and pumped from Piceance Creek at the mouth of Stewart Gulch. The pumping plant would have a capacity of 26 second-feet and would pump the required 18,000 acre-feet against a total dynamic head of 231 feet. The pipeline from the pump to the tract would be about 3 miles long. It would be 36 inches in diameter and would have a capacity of 26 second-feet. The 57,000 acre-feet of water for Tract C-a would be diverted from Piceance Creek at the mouth of Black Sulphur Creek. Two pumping plants, each with a dynamic head of 445 feet and a capacity of 80 second-feet, would lift the water to the tract. The pipeline from Piceance Creek to the tract would be 16 miles long. It would have a diameter of 66 inches and a capacity of 80 second-feet.

Estimated Costs

The construction cost of Juniper Dam and Reservoir is estimated at $13,340,000. The capital costs of the dam and reservoir for development of water for oil shale and associated pumping facilities are estimated at $145,790,000, including $130,160,000 for construction and $15,630,000 for interest during construction. The annual operating costs of the water development for oil shale are estimated at $3,170,000. The share of these costs for each tract is shown below.

	Tracts	
	C-a	C-b
Capital costs		
Construction cost	$103,380,000	$26,780,000
Interest during construction	12,410,000	3,220,000
Total	115,790,000	30,000,000
Annual equivalent cost	7,695,000	1,994,000
Annual operating costs		
Power	2,304,700	520,300
Operation, maintenance, and replacements	262,200	82,800
Total	2,566,900	603,100
Total annual costs		
Total	10,261,900	2,597,100
Per-acre foot	180	145

The power costs are based on purchase of 228,000,000 kilowatt-hours of energy and a maximum demand capacity of 30,600 kilowatts.

Water quality

The water diverted for project purposes would be of good quality, with the total dissolved solids ranging from 150 to 500 mg/l and averaging 230 mg/l. Development of the municipal and industrial portion of the plan outlined would deplete the flow of the Colorado River by an average of 75,000 acre-feet annually. As a result of the depletion the salinity concentrations of the Colorado River at Imperial Dam would be increased by about 5.5 mg/l.

Water rights

Conditional decrees for the Lower Yampa Project are held by the Colorado River Water Conservation District and have an appropriation date of July 6, 1959.

Environmental effects

The impacts of the pipelines would be minimal. The pipeline from Juniper Reservoir to the area of Meeker would follow along existing roads and highways. The impacts of the pipelines diverting from Piceance Creek have been discussed in the plan for pumping from the Colorado River to Tracts C-a and C-b.

Juniper Reservoir would inundate about 21 square miles, including 12 miles of river. The land inundated by the reservoir would include irrigated crop land and land grazed by domestic and big game livestock. The vegetation is sparse and typical of the semi-arid area.

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

ALTERNATIVE SOURCES OF WATER SUPPLY FOR OIL SHALE TRACTS C-a & C-b LOWER YAMPA PROJECT MULTIPLE PURPOSE

DESIGNED _____ SUBMITTED _____
DRAWN _____ RECOMMENDED _____
CHECKED F.J.C. APPROVED _____
SALT LAKE CITY, UTAH AUGUST 21, 1974 OS-400-10

Yellow Jacket Project for Colorado (Tracts C-a and C-b)

Development plan

A Yellow Jacket Project could be constructed to serve oil shale tracts and other purposes in Colorado. The project could provide 57,000 acre-feet of water for Tract C-a, 18,000 acre-feet for Tract C-b, 20,000 acre-feet for development of coal in the Meeker area, and 22,900 acre-feet for irrigation in the White River Basin. Features of the plan are shown on the map on page 81.

Status of investigations

The Bureau of Reclamation has made feasibility investigations of a potential Yellow Jacket Project for Colorado. It first distributed a proposed feasibility report on the project in October 1968. A second proposed report and a proposed draft of an environmental statement were distributed in 1972. Objections were raised by conservationists over environmental and wildlife damage that might be caused by project construction. Investigations are now being made of alternative plans to satisfy many of the objections and still fulfill the primary objectives, including development of water for use by the oil shale industry.

Project features

Storage would be provided by Ripple and Lost Park Reservoirs, both in the White River drainage upstream from Tracts C-a and C-b. Ripple Reservoir would be constructed on the North Fork of the White River at the Garfield-Rio Blanco County line. It would be constructed to a total capacity of 20,000 acre-feet, with an active capacity of 17,000 acre-feet. Lost Park Reservoir would be constructed on Lost Creek, a tributary of

the North Fork of White River. Lost Park Reservoir would have a total capacity of 24,500 acre-feet with an active capacity of 22,000 acre-feet. A feeder canal system would divert water from the Yampa River drainage to Lost Park Reservoir to augment the natural supply. The project would use the direct flows of White River as well as releases from storage. Water for oil shale would be released down the river and rediverted at two separate locations for conveyance to Tracts C-a and C-b. The 18,000 acre-feet of water for Tract C-b would be diverted and pumped from the White River at the mouth of Sheep Creek 2 miles west of the town of Meeker. The 57,000 acre-feet of water for Tract C-a would be diverted and pumped from the White River at the mouth of Yellow Creek.

Two pumping plants would be constructed to lift water to Piceance Creek for Tract C-b. The first would be located on the White River and the second approximately 8 miles south of the White River. Each pumping plant would have a capacity of 26 second-feet and a dynamic head of 615 feet. The pump discharge line would be concrete pressure pipe 36 inches in diameter and 17 miles long. The pipeline would extend up Sheep Creek along Colorado State Highway 13 and would terminate at Fourteen Mile Creek, a tributary of Piceance Creek. Water from the pipeline would be released to the stream channel and rediverted downstream from Piceance Creek near Tract C-b. A third pumping plant with a capacity of 26 second-feet would be located on Piceance Creek at the mouth of Stewart Gulch to pump the water up West Stewart Gulch to the tract. The third pump would be designed to pump against a head of 231 feet. A buried concrete pipe about 3 miles long with a diameter of 36 inches would be constructed from the pump to the oil shale tract.

Two pumping plants would be constructed to lift water to Tract C-a. The first would be located on the White River at the mouth of Yellow Creek and the second about 13 miles to the south. Each plant would have a capacity of 80 second-feet and would be designed to pump against a dynamic head of 767 feet. The pump discharge line would extend up Yellow Creek along an existing unimproved road. It would be a buried concrete pipeline about 26 miles long and with a diameter of 66 inches.

Estimated costs

Construction costs of project reservoirs are estimated at $21,320,000, including $13,840,000 for Ripple Reservoir and $7,480,000 for Lost Park Reservoir. The capital cost of the dam and reservoir for development of water for oil shale and associated pumping facilities is estimated at $82,710,000, including $73,840,000 for construction and $8,870,000 for interest during construction. The annual operating costs of the water development for oil shale are estimated at $2,195,000. The share of the costs for each tract is shown below.

	Tracts	
	C-a	C-b
Capital costs		
Construction costs	$55,700,000	$18,140,000
Interest during construction	6,690,000	2,180,000
Total	62,390,000	20,320,000
Annual equivalent costs	4,147,000	1,351,000
Annual operating costs		
Power	1,482,000	448,000
Operation, maintenance, and replacements	131,000	134,000
Total	1,613,000	582,000
Total annual costs		
Total	5,750,000	1,933,000
Per acre-foot	101	107

Power costs are based on purchase of 163,282,000 kilowatt-hours of energy and a maximum demand capacity of 20,900 kilowatts.

Water quality

Water diverted for project purposes would be of good quality, with total dissolved solids ranging from 200 to 600 mg/l and averaging 360 mg/l. Development of the municipal and industrial water would deplete the flow of the Colorado River by an average of 75,000 acre-feet annually. As a result of the depletion the salinity concentration of the Colorado River at Imperial Dam would be increased by about 4.7 mg/l.

Water rights

Conditional decrees for the Yellow Jacket Project are held by the Yellow Jacket Water Conservancy District and have an appropriation date of November 9, 1953, a priority date of December 11, 1957, and a priority number of 652.

Environmental effects

Impacts of the pipeline and pumping plants would be minimal. The pipelines would be located along existing transportation routes and intermittent stream channels. The pipelines would disturb about 250 to 300 acres of land which would be reseeded and restored to their natural condition after construction.

Ripple Reservoir would provide a new reservoir trout fishery and recreational opportunities in a high mountain setting. The reservoir would inundate 2 miles of high quality trout stream fishery and 365 acres of grazing land for big game and domestic livestock. Use of the basin is now restricted by private ownership but it would be open to the public with

the development of the project. Below the reservoir, flows would exceed the historic average monthly flows in every month except the normal high runoff months of May and June, and fishing would be improved.

Lost Park Reservoir would inundate about 2 miles of fair trout fishing in Lost Creek and about 581 acres in an open sagebrush and grass park used for grazing by big game and livestock. An elk calving area would also be flooded. The reservoir would create a reservoir trout fishery and new recreational opportunities. A new 3-mile road would be constructed adjacent to Lost Creek to provide access to the reservoir but it would not encroach on the stream. Operation of the reservoir would provide a good trout fishery below the reservoir.

FOREST
R21E
R22E
R23E
R24E
DAGGETT CO
UINTAH CO
R25E
R104W
R103W
R102W
R101E
R100W
R99W
R98W
R97W
R96W
R95W
R94W
R93W
R92W
R91W
R90W
R89W
R88W
R20E
T3N
T1N
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DINOSAUR NATIONAL MONUMENT
GREEN RIVER
DIAMOND GULCH
BRUSH CREEK
STEINAKER RESERVOIR
VERNAL
ASHLEY CREEK
DUCHESNE RIVER
PELICAN LAKE
UINTAH & OURAY INDIAN RESERVATION
OURAY
WHITE RIVER
GREEN RIVER
BONANZA
UTAH
COLORADO
UINTAH CO
RIO BLANCO CO
U-a
U-b
UTAH OIL SHALE TRACTS
HILL CREEK
WILLOW CREEK
TAR SAND TRIANGLE
EVACUATION CREEK
MAIN ASPHALT CANYON
ARTESIA
RANGELY
WHITE RIVER
MOFFAT CO
RIO BLANCO CO
SPRING CREEK
BOOCO CREEK
DOUGLAS CREEK
DUCK CREEK
YELLOW CREEK
GULCH
CORRAL GULCH
C-a
SPRINGS DRAW
RYAN GULCH
STATE BLACK SAGHUA CREEK
EUREKA CREEK
PICEANCE CREEK
COLORADO OIL SHALE TRACTS
C-b
HUNTER CREEK
WILLOW CREEK
SCANDARD GULCH
EAST FORK STEWART GULCH
14 MI. CR
RIO BLANCO CO
GARFIELD CO
YAMPA RIVER
LITTLE SNAKE RIVER
SNAKE RIVER
CRAIG
MILK CREEK
MEEKER
FLAG CREEK
SLEEPY CREEK
WHITE RIVER
MARVINE CREEK
NORTH FORK WHITE
SOUTH FORK
MILLER CREEK
WEST RIFLE CREEK
GOVERNMENT CREEK
RIFLE
LOST PARK RESERVOIR
RIPPLE RES.
WYOMING
INDEX MAP

EXPLANATION

Pumping Plant
Pipeline
Existing Reservoir
Potential Reservoir

SCALE OF MILES
5 0 5 10

SCALE OF KILOMETERS
5 0 5 10 15 20

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

ALTERNATIVE SOURCES OF WATER SUPPLY
FOR OIL SHALE TRACTS C-a & C-b
YELLOW JACKET PROJECT
MULTIPLE PURPOSE

DESIGNED J.J. Cotter SUBMITTED
DRAWN [illegible] RECOMMENDED
CHECKED F.J.S. APPROVED
SALT LAKE CITY, UTAH AUGUST 21, 1974 OS-400-8

Yellow Jacket Project for Colorado and Utah (Pumping--White River and Ripple, Lost Park, and Powell Park Reservoir) Tracts C-a and C-b and Tracts U-a and U-b

Development plan

A Yellow Jacket Project could be developed to provide water for the oil shale tracts in both Colorado and Utah as well as water for irrigation in both States. The project would provide 75,000 acre-feet of municipal and industrial water for Tracts C-a and C-b and 36,000 acre-feet of municipal and industrial water for Tracts U-a and U-b. In addition, it would provide 30,000 acre-feet of municipal and industrial water for coal development in the vicinity of Meeker, Colo., and irrigation water in the amount of 22,900 acre-feet for Colorado and 38,000 acre-feet for lands on the Uintah and Ouray Indian Reservation in eastern Utah. Locations of potential features are shown on the map on page 85.

Project features

The features connected with the delivery of water to Colorado would be the same, both in size and location, as those in the Yellow Jacket plan for Colorado discussed in the preceding section. Powell Park Reservoir on the White River, about 12 miles west of Meeker, would be added for service of project purposes in Utah. The reservoir would have a total capacity of 40,000 acre-feet and 38,000 acre-feet of active capacity. Water for oil shale tracts in Utah and the irrigation of Indian lands in Utah would be released to and conveyed by the White River to the area of use. A pumping plant would be provided to pump municipal water to Bonanza. The pump would have a capacity of 40 second-feet and

a dynamic head of 686 feet. Also a pipeline 1.9 miles long and with a diameter of 36 inches would be constructed. Any reregulation and distribution facilities required for the Utah water would be the responsibility of the water users.

Estimated costs

The construction costs of the reservoirs are estimated at $35,800,000, including $13,840,000 for Ripple Reservoir, $7,860,000 for Lost Park Reservoir, and $14,100,000 for Powell Park Reservoir. The capital costs for development of water for oil shale, including a share of the reservoir costs and associated pumping facilities, are estimated at $94,470,000, including $84,340,000 for construction and $10,130,000 for interest during construction. The annual operating costs of the water development for oil shale are estimated at $2,485,000. The share of the costs for each tract is shown below.

	Tracts		
	C-a	C-b	U-a and U-b
Capital costs			
Construction cost	$55,600,000	$17,490,000	$11,250,000
Interest during construction	6,680,000	2,100,000	1,350,000
Total	62,280,000	19,590,000	12,600,000
Annual equivalent cost	4,140,000	1,302,000	838,000
Annual operating costs			
Power	1,482,000	448,000	225,000
Operation, maintenance, and replacements	131,000	134,000	65,000
Total	1,613,000	582,000	290,000
Total annual costs			
Total	5,753,000	1,884,000	1,128,000
Per acre-foot	101	105	32

The power costs are based on purchase of 181,770,000-kilowatt-hours of energy and a maximum demand capacity of 24,300 kilowatts.

CHAPTER IV

MULTIPLE-PURPOSE DEVELOPMENTS

a tunnel bend of 650 feet. Also a pipeline 1.3 miles long and with a diameter of 30 inches would be constructed. Any reregulation and distribution facilities required for the Utah water would be the responsibility of the water users.

Estimated costs

The construction costs of the reservoirs are estimated at $15,800,000, including $13,840,000 for Bigpin Reservoir, $7,660,000 for Lost Park Reservoir, and $18,100,000 for Powell Park Reservoir. The capital costs for development of water for oil shale, including a share of the reservoir costs and associated pumping facilities, are estimated at $24,470,000, including $84,340,000 for construction and $10,130,000 for interest during construction. The annual operating costs of the water development for oil shale are estimated at $2,687,000. The share of the costs for each tract is shown below:

	Tracts		
	Tract C-a	Tract C-b	Tracts C-a and C-b
Capital costs			
Construction cost	$15,000,000	$17,000,000	$32,000,000
Interest during construction	1,900,000	2,230,000	4,130,000
Total	16,900,000	19,230,000	36,130,000
Annual equivalent cost	1,060,000	1,206,000	2,266,000
Annual operating costs			
Power	1,050,000	840,000	1,890,000
Operation, maintenance, and replacements	121,000	150,000	271,000
Total	1,171,000	990,000	2,161,000
Total annual costs			
Total	2,231,000	2,196,000	4,427,000
Per acre-foot	101	100	101

The power costs are based on pumpage of 161,700,000 kilowatt-hours of energy and a maximum demand capacity of 28,300 kilowatts.

Water quality

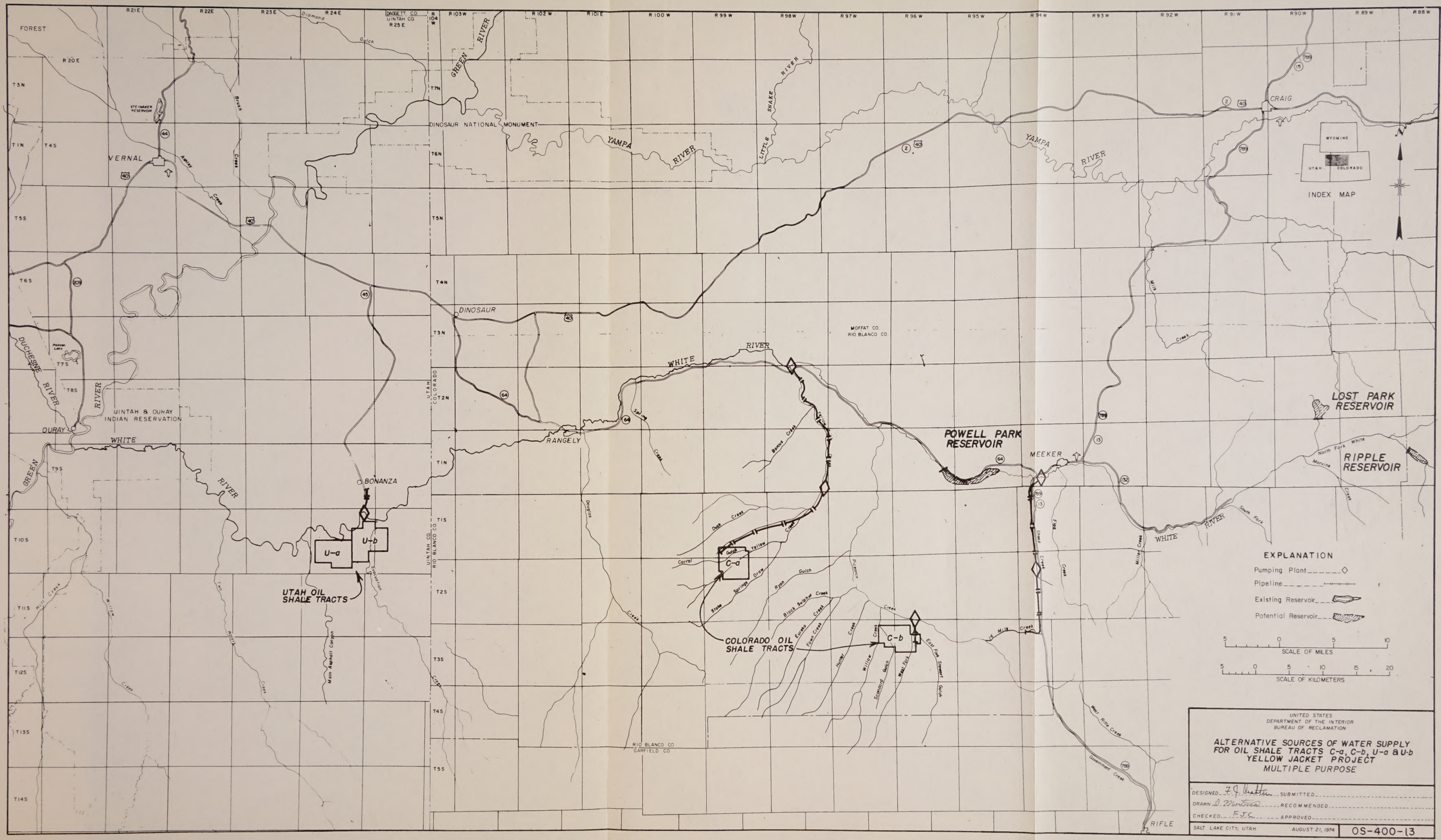
The water diverted for project purposes would be of high quality. In Colorado the dissolved solids would range from 200 to 600 mg/l and average 360 mg/l, while in Utah the dissolved solids would range from 250 to 800 mg/l and average 560 mg/l. The development of water for oil shale would deplete the flows of the Colorado River by an average of 111,000 acre-feet annually. As a result of the depletion the salinity concentrations of the river at Imperial Dam would be increased by about 5.5 mg/l.

Water rights

Conditional decrees for the Yellow Jacket Project are held by the Yellow Jacket Water Conservancy District and have an appropriation date of November 9, 1953, a priority date of December 11, 1957, and a priority number of 652. There are no Colorado decrees for storage in Powell Park Reservoir nor for water use in Utah.

Environmental effects

Powell Park Reservoir would inundate about 970 acres of agricultural land and about 5 miles of the White River. A 3-mile section of Colorado State Highway 62 would require relocation to higher elevation. Effects of other features are discussed in the section on the Yellow Jacket Project for Colorado.



UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

ALTERNATIVE SOURCES OF WATER SUPPLY FOR OIL SHALE TRACTS C-a, C-b, U-a & U-b YELLOW JACKET PROJECT MULTIPLE PURPOSE

DESIGNED T.J. Hartter SUBMITTED
DRAWN D. Montoya RECOMMENDED
CHECKED F.J.S. APPROVED
SALT LAKE CITY, UTAH AUGUST 21, 1974

OS-400-13

Yellow Jacket Project for Colorado and Utah (Pumping and Gravity--White River and Ripple, Lost Park, and Buford Reservoirs) (Tracts C-a and C-b and Tracts U-a and U-b)

Development plan

A Yellow Jacket Project could be developed to provide water for the oil shale tracts in both Colorado and Utah as well as for irrigation in both States and municipal and industrial water for a coal industry development in Colorado in the vicinity of Meeker. Under this plan new opportunities would be created for recreation and fishing. The project would deliver 75,000 acre-feet of municipal and industrial water for Tracts C-a and C-b and 36,000 acre-feet of municipal and industrial water for Tracts U-a and U-b. In addition, it would provide 30,000 acre-feet of municipal and industrial water for use of the coal industry in the vicinity of Meeker and irrigation water in the amount of 22,900 acre-feet for the White River Basin in Colorado and 38,000 acre-feet for lands in the Uintah and Ouray Indian Reservation in eastern Utah. Locations of the potential features of the plan of development are shown in the map on page 90.

Project features

The storage facilities would include Ripple, Lost Park, and Buford Reservoirs. Lost Park and Ripple Reservoirs would be the same as discussed for the Yellow Jacket Project for Colorado. The storage for the water for oil shale development and for irrigation of Indian lands in Utah would be provided at Buford Reservoir. Buford Reservoir

would be located on the White River approximately 1.5 miles below the confluence of the North and South Forks of the White River. The reservoir would have a total capacity of 90,000 acre-feet with an active capacity of 55,000 acre-feet. Water for the oil shale Tracts U-a and U-b and the irrigation of the Indian lands in Utah would be released to and conveyed by the White River to the area of use. A pumping plant to pump municipal water to Bonanza, Utah, would be provided. The pumping plant would have a capacity of 40 second-feet and a dynamic head of 686 feet. The pipeline to Bonanza would be 36 inches in diameter and 1.9 miles long. Any regulation and distribution facilities required for the Utah water would be the responsibility of the water users.

The water for the Colorado tracts would be released to a pipeline heading at the outlet works of Buford Dam. The pipeline would have a capacity of 106 second-feet and a diameter of 72 inches. It would be 32.3 miles long, including 24.5 miles of buried concrete pipe and 7.8 miles of tunnel, and would terminate in Fourteen Mile Creek, a tributary of Piceance Creek. The pipeline would follow generally along the south side of the White River to Flag Creek. It would turn south along Flag Creek and then extend over to Sheep Creek. A 6.8-mile tunnel would carry the water under the divide between Sheep Creek and Fourteen Mile Creek.

Pumping plants would be located on Piceance Creek to lift the water to the oil shale tracts. A pumping plant with a capacity of 26 second-feet would be located at the mouth of Stewart Gulch to lift 18,000 acre-feet of water to Tract C-b. The pipeline from the pumping plant to the

tract would be 3.1 miles long with a diameter of 36 inches. The pump would be designed to pump against a dynamic head of 231 feet. The water for Tract C-a would be diverted from Piceance Creek and pumped at the mouth of Black Sulphur Creek. The pumping plant and one booster pump would lift 57,000 acre-feet of water a total of 890 feet and a distance of 16 miles to the tract. The pumps and pipeline would have a capacity of 80 second-feet.

Estimated costs

Construction costs of the reservoirs are estimated at $56,000,000, including $13,840,000 for Ripple Reservoir, $7,860,000 for Lost Park Reservoir, and $34,300,000 for Buford Reservoir. The capital costs of developing water for oil shale, including a share of the reservoir costs and associated pumping facilities, are estimated at $111,732,000, including $99,752,000 for construction and $11,980,000 for interest during construction. The annual operating costs are estimated at $1,397,900. The share of the costs for each tract is shown below.

	Tracts		
	C-a	C-b	U-a and U-b
Capital costs			
Construction cost	$71,131,000	$16,634,000	$11,987,000
Interest during construction	8,540,000	2,000,000	1,440,000
Total	79,671,000	18,634,000	13,427,000
Annual equivalent costs	5,295,000	1,239,000	893,000
Annual operating costs			
Power	860,000	70,900	225,000
Operation, maintenance, and replacements	125,700	48,300	68,000
Total	985,700	119,200	293,000
Total annual costs			
Total	6,280,700	1,358,200	1,186,000
Per acre-foot	110	76	33

CHAPTER IV

The power costs are based on purchase of 93,500,000 kilowatt-hours of energy and a maximum demand capacity of 13,400 kilowatts.

Water quality

The situation with respect to quality of water diversions and effects of the diversions on water quality downstream would be the same as discussed in the preceding section on the Yellow Jacket Project plan for Colorado and Utah with Powell Park Reservoir.

Water rights

Conditional water decrees for the Yellow Jacket Project are held by the Yellow Jacket Water Conservancy District and have an appropriation date of November 9, 1953, a priority date of December 11, 1957, and a priority number of 652. The district does not have a storage right for Buford Reservoir, nor for any water for use in Utah.

Environmental effects

Buford Reservoir would inundate about 1,200 acres of agricultural land, an existing trout hatchery, and about 7.8 miles of the White River and its two tributaries, the North and South Forks of the White River. Most of this area is now closed to public access but would be open to public use if Buford Reservoir were constructed as part of the Yellow Jacket Project. The impact of the pipeline from Buford Reservoir to Piceance Creek would be minimal and of short duration as the area would be reshaped and reseeded to conform as closely as possible to its natural state.

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

ALTERNATIVE SOURCES OF WATER SUPPLY
OIL SHALE TRACTS C-a, C-b, U-a & U-b
YELLOW JACKET PROJECT
PUMPING AND GRAVITY FLOW
MULTIPLE PURPOSE

DESIGNED D.C.C. SUBMITTED
DRAWN RECOMMENDED
CHECKED APPROVED
SALT LAKE CITY, UTAH AUGUST 21, 1974 OS-400-18

Yellow Jacket Project for Colorado and Utah (Gravity--White River and Ripple, Lost Park, and Buford Reservoirs) Tracts C-a and C-b and Tracts U-a and U-b

Development Plan

This plan for a Yellow Jacket Project would be the same as the plan discussed in the preceding section except that it would be a complete gravity flow system for the Colorado tracts. All the reservoirs, the uses for water, and effects on environment would be the same as in that plan. Locations of the potential features are shown on the map on page 94.

Project features

A gravity pipeline, siphon, and tunnel system would deliver water directly to the Colorado tracts. The alinement and features from Buford Reservoir to the headwaters of Fourteen Mile Creek would be the same as in the preceding plan. From this point the water would continue in a pipeline down Fourteen Mile Creek to the confluence of the East Fork of Stewart Gulch and Piceance Creek. At this point the pipeline would branch, with one line going to Tract C-a and the other to Tract C-b.

The features from Buford Reservoir to the branches would include 35.4 miles of 72-inch diameter pipeline and siphon and 7.8 miles of equivalent size tunnel. The capacity of the features would be 106 second-feet. The line to Tract C-b would go south from the branch up Stewart Gulch a distance of 2.7 miles. It would be 36 inches in diameter with a capacity of 26 second-feet. The other branch would continue down Piceance Creek to the mouth of Black Sulphur Creek and then

would extend westerly to Tract C-a. This line would be 23.9 miles in length, 66 inches in diameter, and would have a capacity of 80 second-feet.

The Utah water would be released from Buford Reservoir down the White River. A pumping plant and 1.9 mile pipeline to the ridge south of Bonanza would be provided for conveyance of the municipal water. Any other regulation and distribution facilities required for the Utah water would be the responsibility of the users. The municipal pumping plant would have a total dynamic head of 690 feet. The capacity of the plant and 36-inch diameter pipeline would be 40 second-feet.

Estimated costs

The capital costs for the development of water for oil shale, including a share of the reservoir costs and associated pumping facilities, are estimated at $133,002,000, including $118,742,000 for construction and $14,260,000 for interest during construction. The annual operating costs are estimated at $470,000. The share of these costs for each tract is shown below.

	Tracts		
	C-a	C-b	U-a and U-b
Capital costs			
Construction cost	$87,666,000	$19,089,000	$11,987,000
Interest during construction	10,520,000	2,300,000	1,440,000
Total	98,186,000	21,389,000	13,427,000
Annual equivalent cost	6,526,000	1,422,000	893,000
Annual operating costs			
Power	0	0	225,000
Operation, maintenance, and replacements	125,000	52,000	68,000
Total	125,000	52,000	293,000
Total annual costs			
Total	6,651,000	1,474,000	1,186,000
Per acre-foot	117	82	33

The power costs are based on purchase of 18,487,000 kilowatt-hours of energy and a maximum demand capacity of 3,400 kilowatts.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OS-400-19
EXPLANATION
Pumping Plant
Pipeline
Existing Reservoir
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SCALE OF MILES
SCALE OF KILOMETERS
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RIPPLE RESERVOIR
BUFORD RESERVOIR
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TUNNEL
COLORADO OIL SHALE TRACTS
UTAH OIL SHALE TRACTS
C-a
C-b
U-a
U-b
VERNAL
CRAIG
MEEKER
RANGELY
DINOSAUR
BONANZA
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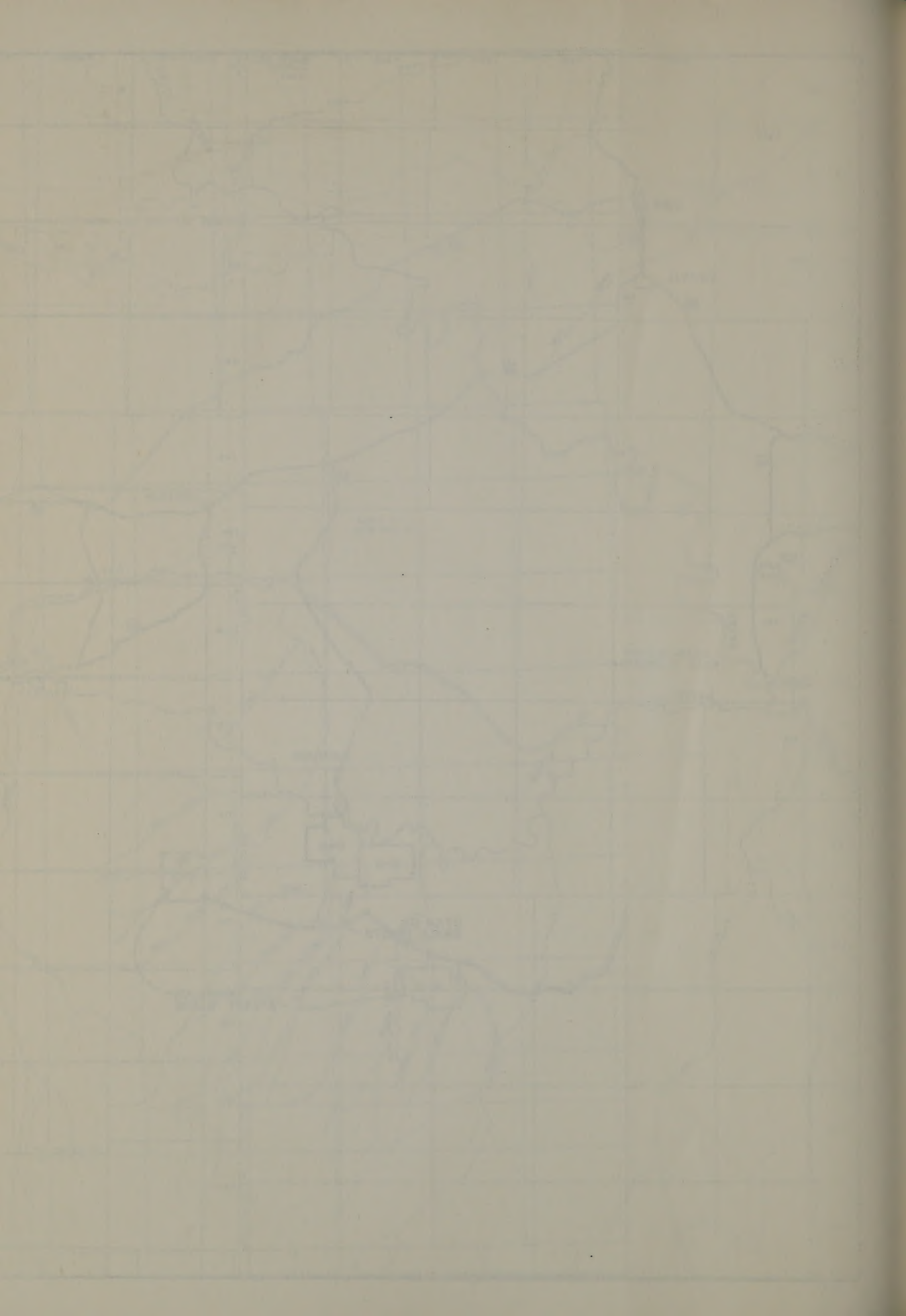
DINOSAUR NATIONAL MONUMENT
UINTAH & OURAY INDIAN RESERVATION
WHITE RIVER
YAMPA RIVER
GREEN RIVER
DUCHESNE RIVER
LITTLE SNAKE RIVER
MOFFAT CO.
RIO BLANCO CO.
GARFIELD CO.
UINTAH CO.
UTAH
COLORADO



Dominguez Reservoir for Tracts C-a and C-b

Appraisal studies have been made of a Dominguez Reservoir on the Gunnison River approximately 9 miles southeast of Grand Junction. Studies have been made of a reservoir with a capacity of 298,000 acre-feet to provide water for municipal and industrial purposes, to provide a reservoir and stream fishery and waterfowl habitat, and to control water quality, sediment, and debris.

The situation of Dominguez Reservoir with respect to supplying water for the oil shale industry is similar to that of the existing Blue Mesa Reservoir previously discussed. Water could be physically delivered to Tracts C-a and C-b but the costs would be prohibitive because of the high pump lifts and long conveyance facilities that would be required. The greatest value of the reservoir so far as oil shale development is concerned would be to make water available to the city of Grand Junction where the population is growing in connection with the oil shale industry.

Costs of Dominguez Reservoir are estimated at approximately $52,790,000. Annual operation, maintenance, and replacement costs of the reservoir are estimated at $66,000.

Savery-Pot Hook Project for Tract C-a

Appraisal estimates have been made of the possibilities of obtaining 57,000 acre-feet of water for Tract C-a through modification of the Savery-Pot Hook Project, which was authorized for construction September 2, 1964, by Public Law 88-568 as a participating project of the Colorado River Storage Project. The project as authorized was planned primarily for irrigation and included construction of two reservoirs--Savery Reservoir on Savery Creek in Wyoming and Pot Hook Reservoir on Slater Creek in Colorado. No change is contemplated in the operation of Savery Reservoir but plans for Pot Hook Reservoir could be modified to provide the water needed for Tract C-a.

Project features

Pot Hook Reservoir would be constructed on Slater Creek about a mile above the stream's confluence with the Little Snake River. It would have a capacity of 65,000 acre-feet (60,000 acre-feet of active capacity). Water would be released from the reservoir to Slater Creek and would continue down the Little Snake River to the Yampa River. Just below the confluence of the Little Snake and Yampa Rivers the water would be pumped for conveyance to Tract C-a. In addition to the reservoir water, some direct flows would be obtained from the Little Snake and Yampa Rivers.

Three pumping plants would be required to lift the water from the Yampa River to Tract C-a. Each plant would have a capacity of 80 second-feet. The first would pump against a dynamic head of 452 feet, the second against a dynamic head of 443 feet, and the third against a dynamic head

CHAPTER IV

Savery-Pot Hook Project for Tract C-a

of 599 feet. Also required would be 49.4 miles of 66-inch concrete pipeline with a capacity of 80 second-feet.

Estimated costs

The capital costs of Pot Hook Reservoir and associated pumping facilities to provide water for oil shale development are estimated at $122,530,000, including $109,400,000 for construction and $13,130,000 for interest during construction. The annual equivalent of these costs is estimated at $8,144,000. The annual operating costs are estimated at $1,659,000, including $1,444,000 for purchase of power and $215,000 for operation, maintenance, and replacements. The sum of the estimated annual equivalent cost and the annual operating cost is $9,803,000 or $172 an acre-foot. The power costs are based on the purchase of 116,000,000 kilowatt-hours of energy and a maximum demand capacity of 15,600 kilowatts.

Water rights

Conditional decrees for the water that would be developed are held by the Colorado River Water Conservation District. The priority number is No. 20A with a priority date of June 5, 1959.

Water quality

The water diverted would have an average content of total dissolved solids of 270 mg/l. This water is of very good quality for the anticipated municipal and industrial uses of the oil shale industry.

Environmental effects

Pot Hook Reservoir would inundate approximately 1,000 acres of land. The pipelines would follow as much as possible along existing highways and roads.

Lower White River Project (For Tracts U-a and U-b)

Development plan

A Watson Reservoir for multiple-purpose development would be constructed on the White River in Uintah County, Utah, at the same location as the single-purpose reservoir discussed in Chapter III. The reservoir would develop flows of the White River for municipal and industrial use, irrigation of lands on the Uintah and Ouray Indian Reservation, and a stream fishery.

The location of the reservoir would make it possible for water to be released to Tracts U-a and U-b and a new community in the vicinity of Bonanza. Municipal water would be pumped from the reservoir to the Bonanza townsite. Irrigation and industrial water would be made available in the White River at points downstream from the reservoir. Fishery water would be released from the reservoir to White River. Locations of the features are shown on the map on page 61.

Project features

Watson Dam and Reservoir and a pumping plant would be required for the development.

Watson Reservoir would have a total capacity of 525,000 acre-feet, of which 350,000 acre-feet would be active for joint use and 175,000 acre-feet would be dead and inactive for retention of sediment over a 100-year period. The dam would be an earthfill structure about 230 feet high. A spillway capacity of 40,000 second-feet as well as reservoir surcharge is planned to protect the dam against floods. An outlet capacity of 2,200 second-feet would also be provided.

The pumping plant would be used to pump municipal water to the townsite of Bonanza. The plant would pump a maximum of 40 second-feet from the reservoir outlet. The water would flow through a 3.2-mile-long pipeline to a ridge just south of Bonanza, where it would connect to a distribution system. The pump lift would be about 480 feet. Power for pumping could be obtained from a 69-kilovolt line located at Bonanza.

Estimated costs

The construction cost of Watson Dam and Reservoir is estimated at $40,900,000. The capital costs for development of water for oil shale, including a share of the reservoir costs and associated pumping facilities, are estimated at $14,490,000, including $12,930,000 for construction and $1,560,000 for interest during construction. The annual equivalent of these costs is $963,000. The annual operating costs are estimated at $209,500, including $156,900 for purchase of power and $52,600 for operation, maintenance, and replacements. The sum of the annual equivalent cost and the annual operating costs is $1,172,500 or $33 an acre-foot. The power costs are based on the purchase of 12,920,000 kilowatt-hours of energy and a maximum demand capacity of 2,400 kilowatts.

Water supply and rights

The irrigation water would be developed to provide a supply for Group 6 and 7 Indian lands near Ouray, Utah. The water rights for this supply would be the same as discussed for a single-purpose development of Watson Reservoir.

The Fish and Wildlife Service has recommended that streamflows of 210 second-feet during the winter and 420 second-feet during the summer be maintained for fishery flows in the White River. Natural flows would be supplemented with reservoir releases for augmentation of the stream flows at the recommended level.

A water supply of about 158,000 acre-feet annually would be developed. Of the total, 38,000 would be for irrigation on the Uintah and Ouray Indian Reservation, 100,000 for municipal and industrial uses, (36,000 acre-feet for development of Tracts U-a and U-b and the new community and 64,000 acre-feet for other municipal and industrial uses), and 20,000 for stream fishery. Water rights for the purposes other than irrigation of Indian-owned lands could be the rights held by Utah Division of Water Resources as discussed in the single-purpose development of Watson River.

Stream depletions

The estimated depletion of the White River flows resulting from the development of Tracts U-a and U-b and the new community would be about 24,000 acre-feet per year. This depletion would increase the salinity of the Colorado River at Imperial Dam by about 1.4 mg/l.

Water quality

The salinity of the water in the White River at the Watson Dam site averages about 550 mg/l. With storage in a large reservoir the mixing of flows would maintain the quality at about the average of 550 mg/l. This would provide a water supply with a quality adequate for municipal purposes.

Environmental effects

The White River has been included in a study for proposed wild and scenic river status. The construction of a storage reservoir would change this reach of the river from the present status.

For the multi-purpose plan the reservoir would include storage capacity specifically for stream fishery releases. The flow in the White River from the dam to the Green River would be maintained at 420 second-feet in the April to September period and 210 second-feet during the October to March period. This section of river is about 30 miles long. The reservoir's active capacity has been increased by 120,000 acre-feet to store water for these fishery releases. The cost of the project has been increased by about $6,000,000 for this storage. The reservoir's large dead and inactive pool of 175,000 acre-feet would be available for recreation and fishery purposes, especially in the early years of project operation.

In the 30-mile section of White River from Watson Dam to the Green River, the sediment load would be reduced by about 95 percent because of the sediment retention in the reservoir basin.

An area of about 7,300 acres of land along the river would be inundated by the reservoir at normal water surface elevation. The steep shoreline of the reservoir would limit the recreation potential to areas where access is possible. The water surface would have an annual fluctuation of about 63 feet. Because of the shoreline steepness, however, only small areas of mud flats would be exposed except at the upstream

end of the basin. The reseroir would inundate about 21 miles of the White River in Utah and Colorado.

Other impacts on the area would be an access road to the dam and about 4 miles of powerline from Bonanza to the dam and pumping plant.

CHAPTER V

WATER RIGHTS AND CONTRACTS

Water Rights and Priorities

The availability of water for the prototype oil shale development of Colorado Tracts C-a and C-b and Utah Tracts U-a and U-b is directly related to the priority of the water rights under which diversions to the tracts would take place. Two primary considerations in determining the amount of water that can be diverted under a given water right priority are (1) the amount of water physically available in the source, and (2) the amount of water available within the State's entitlement from the Colorado River system. Generally, the quantity of water that is estimated as being available under conservative assumptions for either of the two above conditions is greatly exceeded by the existing water rights in good standing in the States of Colorado and Utah.

As an example of the first condition, the average annual runoff of the White River is approximately 700 cubic feet per second or 500,000 acre-feet per year. There are conditional decrees for the White River in Colorado covering approximately 3,790 second-feet and 1,092,000 acre-feet. In addition there are unperfected rights in Utah, including approved and unapproved applications, covering approximately 730 second-feet and 295,500 acre-feet. These do not include Winters' Doctrine rights that may be claimed by the Ute Indians for the Uintah and Ouray Indian Reservation in Utah, claims by the Department of the Navy to

develop the Naval oil shale withdrawn lands, claims by the Bureau of Land Management and the Forest Service to administer public lands, flows required to prevent losses or damage to fish and wildlife, flows required to comply with the Endangered Species Act of 1973, and possible claims that may be asserted in connection with the Wild and Scenic Rivers Act.

The Uintah and Ouray Indian Reservation in Utah was established June 5, 1882, and under the so-called Winters' Doctrine, that date would be the priority date of water rights sought by the Indians. The origin of the Winters' Doctrine is the case of Winters' v. United States, 207 U.S. 564, 52 L.Ed. 340, 28 S.Ct. 207, (1908), which was followed by the same court in the United States v. Powers, 305 U.S. 527, 83 L.Ed. 330, 59 S.Ct. 344, (1939), and most recently, in Arizona v. California, 373 U.S. 546, 10 L.Ed. 2d 542, 83 S.Ct. 1468, (1963). The Supreme Court of the United States referred to the Winters' case and said:

> "We follow it now and agree that the United States did reserve the water rights of the Indians effective as of the time the Indian reservations were created."

Part of the reservation land under the White River is covered by applications for water rights with the State Engineer's office of the State of Utah. There would appear to be no question concerning the water for irrigation pursuant to the Winters' Doctrine; however, there is no known case which has adjudicated the reservation of water for industrial development on an Indian reservation. The United States submitted a claim in an adjudication in Colorado on behalf of the Indian reservation seeking water from the White River. The amount of the rights claimed by the Indians in Utah has not been adjudicated in the courts of the State.

CHAPTER V

WATER RIGHTS AND CONFLICTS

Although it is impossible to determine what depletions will take place under existing decrees, applications, and claims, it is obvious that they could exceed the 500,000 acre-feet available even if sufficient storage were built to regulate the entire runoff of the White River. This points out the need of some agreement between the States of Colorado and Utah or a compact on the White River, defining how the waters of the White River are to be developed and what division is to be made between the two States.

As an example of the second condition for determining the amount of water that can be diverted, a conservative estimate of Utah's entitlement to water from the Colorado River system is 1,322,000 acre-feet a year. The 1974 use is estimated as being 825,000 acre-feet. The unused supply is 497,000 acre-feet a year. As shown in the table on the next page, the unperfected water rights in the Colorado River Basin in Utah total approximately 19,880 second-feet and 13,056,000 acre-feet. While once again it is impossible to determine what depletions will take place under these applications, since several large rights are for hydropower generation and river regulation, it is obvious that they could exceed by many times the 497,000 acre-feet a year that is available. The table on page 107 shows that approximately 8,172,000 acre-feet and 14,750 second-feet of these rights have earlier priorities than the February 15, 1965, priority of the earliest water right filed in Utah for oil shale developments. Data to make this type of comparison in Colorado are not available at this time.

Magnitude and status of water rights in Colorado River Basin in Utah

Area	Water right status: Perfected1/ Cubic feet per second	Perfected1/ Acre-feet	Unperfected2/ Cubic feet per second	Unperfected2/ Acre-feet	Remarks
North slopes of Uinta Mountains	780	500	8,510	5,464,500	Unperfected rights include 4,000,000 ac.-ft. and 8,000 c.f.s. for Flaming Gorge
Duchesne River	4,580	223,400	4,200	3,373,800	Unperfected rights include 1,500,000 ac.-ft. for Bonneville Unit, 100,000 ac.-ft. for Upalco Unit, 100,000 ac.-ft. for Uintah Unit, and 1,400,000 ac.-ft. for Ute Indian Unit, Central Utah Project
Ashley and Brush Creeks	590	-	670	898,800	
Minnie Maud Creek	70	100	120	5,900	
White River and vicinity	170	500	730	295,500	
North side of Colorado River	80	-	80	-	
South side of Colorado River	480	1,000	140	19,000	
Southeast of San Juan	270	2,500	50	936,900	Unperfected rights include 750,000 ac.-ft. claim by W. Clegg
Price River	1,530	47,900	400	249,000	
East side of Green River	120	800	2,580	-	Unperfected rights include 2,500 c.f.s. filing by Utah Power & Light Co.
San Rafael River	940	24,600	840	727,300	
Dirty Devil River	540	27,200	780	419,200	
Escalante River	250	8,100	200	278,500	
Northwest San Juan	-	-	-	-	Magnitudes of perfected and unperfected rights in this division are negligible
Paria River	70	2,900	580	387,500	
Total	10,470	339,500	19,880	13,055,900	

1/ Perfected rights include decreed, certificated, diligence, proof, and election claims.
2/ Unperfected rights include approved and unapproved applications.

Summary of unperfected water rights in Colorado River Basin in Utah[1/]

	Unit	Approved applications	Unapproved applications	Total
United States	c.f.s.	8,565	673	9,238
	a.f.	4,795,283	2,655,000	7,450,283
Utah Division of Water Resources	c.f.s.	415	4,078	4,493
	a.f.	110,903	340,616	451,519
Companies	c.f.s.	520	128	648
	a.f.	101,567	155,800	257,367
Individuals	c.f.s.	238	137	375
	a.f.	11,268	1,880	13,148
Total	c.f.s.	9,738	5,016	14,754
	a.f.	5,019,021	3,153,296	8,172,317

1/ Includes only surface water rights of 1 cubic foot per second or larger and with priorities earlier than January 1965.

The preceding discussions demonstrate that unless a water right is obtained with an earlier priority than the rights now held by the lessees of Tracts C-a, C-b, U-a, and U-b, there may not be much if any water available for their development. An alternative would be for early unperfected water rights to be cancelled or subordinated to later oil shale water rights. This may require a change in Colorado water law. It would also mean stricter administration of water rights in both Colorado and Utah to eliminate speculative rights.

Gulf Mineral Resources Company, representing Gulf Oil Corporation and Standard Oil Company of Indiana, the lessees of Tract C-a, filed an application on February 20, 1974, for a conditional decree on Yellow Creek Reservoir. The source of water supply covered in this filing is White River. Realizing that a 1974 water right priority would not yield a firm water supply, Gulf Mineral Resources Company has requested from the Bureau of Reclamation an option contract for 30,000 acre-feet of water from Ruedi Reservoir and up to 70,000 acre-feet of water from either the Yellow Jacket Project or Lower Yampa Project or a combination of the two.

It is understood that some of the participants in Tract C-b (Atlantic Richfield, Shell Oil, the Shale Oil Corporation, and Ashland Oil) own water rights from the Colorado River and White River. At this time, however, none of the rights have been committed to the development of Tract C-b. It is further understood that it is the intent of the lessees of Tract C-b to obtain the water supply for the development of this tract from ground water.

Phillips Petroleum Company, Sun Oil Company, and Sohio Petroleum Company, the lessees of Tract U-a and U-b, contemplate a joint development of these two tracts. Sohio Petroleum Company owns a 15-second-foot water right in White River with a February 15, 1965, priority. This right will not yield the 50 second-feet or 36,000 acre-feet a year that would be required to develop the tracts and support a new community in the vicinity of Bonanza. The three lessees have requested the Utah Division of Water Resources, who owns Application No. 36979, with a May 19, 1965, priority, covering 350 second-feet and 250,000 acre-feet of water from White River, its tributaries and ground water, to segregate 50 second-feet of Application No. 36979 and assign it to them. This would be used as an interim supply for Tracts U-a and U-b and the community until a firmer water supply could be obtained from storage on the White River or Green River.

The lessees of Tracts U-a and U-b have indicated an interest in an option contract with the Bureau of Reclamation for 36,000 acre-feet of water from Flaming Gorge Reservoir until storage on the White River can be completed and water obtained from that source. Such a contract would be contingent on a definition by the State of Utah of its priorities for use of the water within its entitlement to water of the Colorado River system, including use by the Ute Indians.

Procedures for Contracting with the United States for Water Service

Water available in Bureau of Reclamation reservoirs may be acquired by terms of a water service contract. Water would be made available in

the reservoir, or with optional delivery downstream. The contract would generally cover a period of 40 years, with provisions for renewal.

Water rates would be established to cover payment of operation, maintenance, and replacement costs and construction costs with interest. Rates for water from existing reservoirs would be subject to negotiation at the time of contract. Rates would vary for alternative sources of water as a function of relative development costs. Provisions would be made for periodic review of rates and increases as may be necessary.

A contract would include a number of standard clauses, including anti-discrimination, compliance with the National Environmental Policy Act, and State and Federal water quality requirements. Contracts may include option agreements covering water quantities, delivery build-up, and use periods. Option payments or readiness-to-serve charges would be included along with a termination date. A third party cancellation provision may also be included if another customer were willing to sign a contract, take delivery of water, and start making full payments.

Contracts for water from Bureau of Reclamation projects would be discussed with official State representatives and other interested parties prior to execution.

CHAPTER VI

SUMMARY

The tables on the following three pages compare pertinent data for several physical alternative plans for supplying water for the development of oil shale Tracts C-a and C-b in Colorado and Tracts U-a and U-b in Utah. Data are shown only for the alternative plans that appear to be the most desirable. Additional alternatives were mentioned in previous chapters but these are not included in the summary tables as they are not as attractive from a cost and environmental standpoint.

The data presented in the following tables permit a good comparison of physical alternatives. Because of water right problems and water uses other than oil shale, the physical alternatives may not be fully comparable. The data presented are based on reconnaissance information and changes should be expected following more detailed studies.

CHAPTER VI

SUMMARY

Summary of alternatives for supplying water to prototype oil shale development in Colorado (Tract C-a)

	Single-purpose developments				Multiple-purpose developments					
Source of water	Pumping from Colorado River Colorado River and Ruedi Reservoir	Yellow Creek Reservoir White River	Ripple Reservoir White River	Pumping from Colorado River (Joint with C-b) Colorado River and Ruedi Reservoir	West Divide Project (Joint with C-b) Colorado River and Una Reservoir	Lower Yampa Project (Joint with C-b) Yampa River and Juniper Reservoir	Yellow Jacket Project (Joint with C-b) White River and Ripple and Lost Park Reservoirs	Yellow Jacket Project (Joint with C-b, U-a, and U-b--Pumping) White River and Ripple, Lost Park, and Powell Park Reservoirs	Yellow Jacket Project (Joint with C-b, U-a, and U-b--Pumping and gravity) White River and Ripple, Lost Park, and Buford Reservoirs	Yellow Jacket Project (Joint with C-b, U-a, U-b--Gravity) White River and Ripple, Lost Park, and Buford Reservoirs
Annual firm water supply (ac.-ft.)										
Industrial	57,000	57,000	57,000	57,000	57,000	57,000	57,000	57,000	57,000	57,000
Quality of water diverted (Total dissolved solids--mg/l)										
Average	500	270	320	500	500	230	360	360	360	360
Range	160-930		200-500	160-930	160-930	150-500	200-600	200-600	200-600	200-600
Capital costs										
Construction cost (Jan. 1974 prices)	$64,800,000	$54,900,000	$55,700,000	$55,970,000	$97,740,000	$103,380,000	$55,700,000	$55,600,000	$71,131,000	$87,666,000
Interest during construction	7,780,000	6,590,000	6,690,000	6,720,000	11,730,000	12,410,000	6,690,000	6,680,000	8,540,000	10,520,000
Total	72,580,000	61,490,000	62,390,000	62,690,000	109,470,000	115,790,000	62,390,000	62,280,000	79,671,000	98,186,000
Annual equivalent cost (6 percent, 40 years)	4,824,000	4,087,000	4,147,000	4,167,000	7,275,000	7,695,000	4,147,000	4,140,000	5,295,000	6,526,000
Annual operating costs										
Water purchase	1/$450,000	1/0	1/0	1/$450,000	0	0	0	0	0	0
Power	2,985,000	$1,691,000	$1,482,000	2,949,500	$2,949,500	$2,304,700	$1,482,000	$1,482,000	$860,000	0
Operation, maintenance, and replacements	299,000	189,000	131,000	273,500	283,500	262,200	131,000	131,000	125,700	$125,000
Total	3,734,000	1,880,000	1,613,000	3,673,000	3,233,000	2,566,900	1,613,000	1,613,000	985,700	125,000
Total annual costs										
Total	$8,558,000	$5,967,000	$5,760,000	$7,840,000	$10,508,000	$10,261,900	$5,750,000	$5,753,000	$6,280,700	$6,651,000
Per acre-foot of water supplied	150	105	101	138	185	180	101	101	110	117

1/ Does not include costs for purchase of senior water rights.

Summary of alternatives for supplying water to prototype oil shale development in Colorado (Tract C-b)

	Single-purpose developments			Multiple-purpose developments					
	Pumping from Colorado River	Ripple Reservoir	Pumping from Colorado River (Joint with C-a)	West Divide Project (Joint with C-a)	Lower Yampa Project (Joint with C-a)	Yellow Jacket Project (Joint with C-a)	Yellow Jacket Project (Joint with C-a, U-a, and U-b--Pumping)	Yellow Jacket Project (Joint with C-a, U-a, and U-b--Pumping and gravity)	Yellow Jacket Project (Joint with C-a and C-b--Gravity)
Source of water	Colorado River	White River	Colorado River and Ruedi Reservoir	Colorado River and Una Reservoir	Yampa River and Juniper Reservoir	White River and Ripple and Lost Park Reservoirs	White River and Ripple, Lost Park, and Powell Park Reservoirs	White River and Ripple, Lost Park, and Buford Reservoirs	White River and Ripple, Lost Park, and Buford Reservoirs
Annual firm water supply (ac.-ft.)									
Industrial	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000
Quality of water diverted (Total dissolved solids-mg/l)									
Average	500	320	500	500	230	360	360	320	320
Range	160-930	200-500	160-930	160-930	150-500	200-600	200-500	200-500	200-500
Capital costs									
Construction cost (Jan. 1974 prices)	$19,900,000	$19,400,000	$13,130,000	$30,860,000	$26,780,000	$18,140,000	$17,490,000	$16,634,000	$19,089,000
Interest during construction	2,390,000	2,330,000	1,580,000	3,710,000	3,220,000	2,180,000	2,100,000	2,000,000	2,300,000
Total	22.290.000	21,730,000	14,710.000	34,570,000	30,000,000	20,320,000	19,590,000	18,634,000	21,389,000
Annual equivalent cost (6 percent, 40 years)	1,482,000	1,444,000	978,000	2,300,000	1,994,000	1,351,000	1,302,000	1,239,000	1,422,000
Annual operating costs									
Water purchase	1/ 0	1/ 0	1/ 0	0	0	0	0	0	0
Power	$783,000	$448,000	$857,500	$857,500	$520,300	$448,000	$448,000	$70,900	0
Operation, maintenance, and replacements	181,000	134,000	89,500	89,500	82,800	134,000	134,000	48,300	52,000
Total	964,000	582,000	947,000	947,000	603,100	582,000	582,000	119,200	52,000
Total annual costs									
Total	$2,446,000	$2,026,000	$1,925,000	$3,247,000	$2,597,100	$1,933,000	$1,884,000	$1,358,200	$1,474,000
Per acre-foot of water supplied	136	113	107	180	145	107	105	76	82

1/ Does not include costs for purchase of senior water rights.

Summary of alternatives for supplying water to prototype oil shale development in Utah (Tracts U-a and U-b)

	Single-purpose developments					Multiple-purpose developments			
Source of water	Pumping from Green River near Ashley Creek Flaming Gorge Reservoir	Pumping from Green River near Ouray, Utah Starvation Reservoir	Tyzack Reservoir Authorized Tyzack Reservoir	Watson Reservoir White River	Hells Hole Canyon Reservoir (offstream) White River	Lower White River Project White River and Watson Reservoir	Yellow Jacket Project (Joint with C-a and C-b--Pumping) White River and Ripple, Lost Park, and Powell Park Reservoirs	Yellow Jacket Project (Joint with C-a and C-b Pumping and gravity) White River and Ripple, Lost Park, and Buford Reservoirs	Yellow Jacket Project (Joint with C-a and C-b--Gravity) White River and Ripple, Lost Park, and Buford Reservoirs
Annual firm water supply (ac.-ft.)									
Industrial	18,000	18,000	0	18,000	18,000	18,000	18,000	18,000	18,000
Municipal	18,000	18,000	8,000	18,000	18,000	18,000	18,000	18,000	18,000
Total	36,000	36,000	8,000	36,000	36,000	36,000	36,000	36,000	36,000
Quality of water diverted (Total dissolved solids--mg/l)									
Average	430	450	150	550	500	550	560	560	560
Range	130-650	150-700					250-800	250-800	250-800
Capital costs									
Construction cost (Jan. 1974 prices)	$24,325,000	$28,720,000	$14,450,000	$21,950,000	$27,410,000	$12,930,000	$11,250,000	$11,987,000	$11,987,000
Interest during construction	2,920,000	3,450,000	1,740,000	2,640,000	3,290,000	1,560,000	1,350,000	1,440,000	1,440,000
Total	27,245,000	32,170,000	16,190,000	24,590,000	30,700,000	14,490,000	12,600,000	13,427,000	13,427,000
Annual equivalent cost (6 percent, 40 years)	1,811,000	2,138,000	1,076,000	1,635,000	2,041,000	963,000	838,000	893,000	893,000
Annual operating costs									
Water purchase	$360,000	$1,980,000	$440,000	0	0	0	0	0	0
Power	735,900	1,105,400	104,500	$183,200	$348,900	$156,900	$225,000	$225,000	$225,000
Operation, maintenance, and replacements	148,800	169,600	250,000	63,900	110,600	52,600	65,000	68,000	68,000
Total	1,244,700	3,255,000	794,500	247,100	459,500	209,500	290,000	293,000	293,000
Total annual costs									
Total	$3,055,700	$5,393,000	$1,870,500	$1,882,100	$2,500,500	$1,172,500	$1,128,000	$1,186,000	1,186,000
Per acre-foot of water supplied	85	150	234	53	70	33	32	33	33